A star (✱) indicates that the Abstract deals with Apparatus and Instruments.

SEPTEMBER, 1938.

GENERAL PHYSICS.

ADSORPTION (see Surface Properties).

ATOMIC AND MOLECULAR STRUCTURE.

3432. Passage of Particles through Spherical Potential Barriers. G. Badarau. *Comptes Rendus*, 207. *pp.* 39–42, *July* 4, 1938.—A mathematical treatment, for the case of nuclear charged particles, is developed, based on the Brillouin-Wentzel approximation method, and an expression for the transmission coefficient is deduced. Results are considered in relation to Al. N. M. B.

3433. Constitution of Atomic Nuclei. A. Véronnet. *Comptes Rendus*, 207. *pp.* 42–44, *July* 4, 1938.—A theoretical system is developed by which the constitution of the elements and their isotopes can be successively built up on the basis of the nuclear constitution of H_2^+ and H_3^+, and a general expression for the constitution is derived. N. M. B.

3434. Structure of Atomic Nuclei. F. J. de Wiśniewski. *Acta Physica Polonica*, 7. 1. *pp.* 5–9, 1938. *In French.*—A theory of γ-radiation without nuclear transformation is developed and applied to $^7_3$Li. Calculated and experimental values are in good agreement. W. R. A.

3435. Interaction Forces in Electrodynamics and in the Field Theory of Nuclear Forces. E. C. G. Stueckelberg. *Helv. Phys. Acta*, 11. 4. *pp.* 299–328, 1938. *In German.*—The mathematical properties of interactions transmitted by intermediate particles (such as photons, heavy electrons, etc.) are investigated by the method of many times. R. P.

3436. Charge-Dependence of Nuclear Forces. N. Kemmer. *Cambridge Phil. Soc., Proc.* 34. *pp.* 354–364, *July*, 1938.—In this mathematical paper the author deduces by specialisation a satisfactory theory of heavy quanta, charged and uncharged, collects the essential equations in a practical form, and then discusses in detail the most important application, *viz.*, the resulting nuclear potential. H. H. Ho.

3437. Binding Energies of Hydrogen Isotopes. A. H. Wilson. *Cambridge Phil. Soc., Proc.* 34. *pp.* 365–374, *July*, 1938.—The wave equation for the deuteron in its ground state is solved on the assumption that the mutual potential energy of a neutron and a proton is of the form $r^{-1}e^{-\lambda r}$. The binding energy of H^3 is calculated approximately by the variation method. AUTHOR.

3438. Isotope Abundance of Common Lead. A. O. Nier. *Am. Chem. Soc., J.* 60. *pp.* 1571–1576, *July*, 1938.—A mass spectrographic study of the isotopes of 12 samples of common lead shows that the relative abundances vary considerably in spite of a nearly constant atomic weight. A tentative explanation for the variations is found if one arbitrarily considers some of the samples to be "uncontaminated" lead and the others "uncontaminated" lead to which has been added approximately equal quantities of uranium and thorium leads. As the minerals from which the lead was obtained are essentially free of Th and U, such contamination probably took place before the mineral was formed. A search for the isotopes Pb^{210}, Pb^{209}, Pb^{205}, and Pb^{203} indicated that if such isotopes exist at all they must exist with much lower abundances than was at one time supposed. AUTHOR.

3439. Fractionation of Li and K Isotopes by Chemical Exchange with Zeolites. T. I. Taylor and H. C. Urey. *J. Chem. Phys.* 6. *pp.* 429–438, *Aug.*, 1938.—A study has been made of the fractionation of Li isotopes by electrolysis and of the Li, K and N isotopes by chemical exchange with zeolites. The fractionation factor obtained by a " batch " electrolysis of LiCl solution was 1·039. The normal abundance ratio of the Li and K isotopes was determined and found to be 11·71 ± 0·14 for $Li^7 : Li^6$ and 14·10 ± 0·09 for $K^{39} : K^{41}$. The fractionation factor for the Li isotopes in exchange with sodium zeolite was found to be 1·022. A partial separation of the Li, K and N isotopes has been effected using long columns filled with zeolites. Both an increase and a decrease of about 25% from the normal abundance ratio has been obtained for the Li isotopes and a change of about 10% for the K and N isotopes. Some of the factors involved in the mechanism of the process are discussed. AUTHORS.

3440. Isotopic Constitution of Sr, Ba, Bi, Tl and Hg. A. O. Nier. *Phys. Rev.* 54. *pp.* 275–278, *Aug.* 15, 1938.—A mass-spectrographic study of the isotopic constitution of Sr, Ba, Bi and Tl has been made. Although the sensitivity and resolving power of the apparatus were sufficient to detect extremely rare isotopes, no new ones were found. Relative abundances of the isotopes of Sr, Ba and Tl were determined. It was possible to show that if Hg^{203} exists it must be with an abundance less than one-tenth of that at one time assigned to it by Aston. AUTHOR.

3441. Electron Diffraction Study of Di- and Tri-Germane. L. Pauling, A. W. Laubengayer and J. L. Hoard. *Am. Chem. Soc., J.* 60. *pp.* 1605–1607, *July*, 1938.—The Ge–Ge bond distance in both digermane and trigermane is found by the electron diffraction method to be about 2·41 ± 0·02 Å. AUTHORS.

3442. Atomic and Ionic Radii. Parts I and II. W. Hume-Rothery and G. V. Raynor. Part III. G. V. Raynor. *Phil. Mag.* 26. *pp.* 129–165, *July*, 1938.—Part I discusses what constitutes the size of an atom in a metallic structure. There are two general types of structure, *i.e.*, the " open " type in which the ionic radius is small compared with the interatomic distance, while in a lattice of the " full " type the ionic radii are nearly equal to the interatomic distances. Consequently their properties differ considerably. There should be a difference in the compressibilities of metals of the two types, and this is substantially borne out by experiment. In an open type of lattice the valency electrons control the properties, and to a first approximation they may be treated as an electron gas. It can be shown that the compressibility is proportional to $(V/N)^{5/3}$ where N is the number of electrons in volume V, and V is the extra-ionic volume in the unit cell. The experimental data of Bridgman for the alkali metals are in agreement with this theory. The departures of other metal lattices are considered and it may be claimed that the compressibilities agree with the picture of metals given by considering atomic radii and extra-ionic volumes. In Part II the theory is applied to the problem of alloys. Examples are discussed illustrating general principles or systems which have hitherto proved difficult to understand. Although in many cases simple considerations of ionic size give an adequate explanation of solubility effects, there are complicating factors, one of the most important being mutual deformation of the ions of the constituent metals. This effect is dealt with in detail in Part III. Present knowledge of the polarisation of ions does not, however, permit the considerations of the deformabilities of ions being expanded into a general law for metal systems. C. J. B. C.

3443. Intermolecular Forces. J. N. Friend. *Faraday Soc., Trans.* 34. *pp.* 813–816, *July,* 1938.—Viscosity and density data relating to many organic liquids support the view that the attractive forces between the molecules vary inversely as the eighth power of the distance between them. P. H. B.

See also Abstracts 3486, 3489, 3490, 3491, 3774, 3816, 3834.

COLLOIDS.

3444. Dispersion of Depolarisation of Light-Scattering in Colloids. R. S. Krishnan. *Kolloid Zeits.* 84. *pp.* 2–8, *July,* 1938.—The imperfection of the polarisation (" depolarisation ") of the Tyndall scattering, in colloids can be expressed in terms of the quantities ρ_u, ρ_v, and ρ_h. Here ρ is the ratio of the intensity of the weaker component to the stronger, when the scattering is through 90°. u, v and h are applied to the three cases of the incident light being unpolarised, or vertically or horizontally polarised, respectively. To draw conclusions as to the magnitude, nature and structure of the colloid particles, a determination of each of these three quantities is necessary. ρ_v gives information about the nature or structure of the particles, ρ_h about their size. They are related with ρ_u by $\rho_u = \left(1 + \frac{1}{\rho_h}\right) / \left(1 + \frac{1}{\rho_v}\right)$. This holds for all wave-lengths and particles, provided the latter are randomly distributed. When the particles are large and aspherical, the depolarisations show a great dependence on the wave-length of the incident beam. An experimental method is described for measuring this dispersion of the depolarisation. Conditions for this dispersion to occur with any colloid solution, are discussed. [See following Abstract.] A. C. M.

3445. Molecular Aggregation and Light Scattering. R. S. Krishnan. *Kolloid Zeits.* 84. *pp.* 8–15, *July,* 1938.—The phenomenon of opalescence, which is exhibited by liquid mixtures near the critical solution temperature, is described, and some consequences of opalescence are explained. The colloidal nature of such liquid mixtures, neglected by others, is discussed with reference to the colour of the opalescence, and to the anomalies in the viscosity and in the electrical, magnetic and mechanical double refraction. The optical methods, which measure ρ_h [see preceding Abstract] are apt for finding molecular aggregation, and so for demonstrating the similarity of critical liquid mixtures, and colloidal emulsions. The results are described in this paper. The method is sensitive, and shows such an aggregation to be already occurring in liquid mixtures already well below the opalescence temperature. A. C. M.

3446. Effect of Electrolytes on the Viscosity of $Fe(OH)_3$ Sol. S. Thèvenet. *Comptes Rendus,* 207. *pp.* 68–71, *July* 4, 1938.—The effect of KCl, $NaCl$, NH_4Cl, $BaCl_2$, $AlCl_3$ and $ThCl_4$ on the viscosity of a $Fe(OH)_3$ sol was first investigated. Being a positively charged sol it would be expected that the kation of the added electrolyte would be ineffective and this was verified. When the effect of KCl, K_2SO_4, K_3PO_4, and $K_4Fe(CN)_6$ was investigated it was found that the concentration of the added electrolyte for which the viscosity of the sol was a minimum depended chiefly on the valency of the anion. In the case of salts with polyvalent anions, *e.g.*, K_3PO_4, $K_4Fe(CN)_6$, and sodium citrate, for which there are two zones of coagulation, the effect on the viscosity was determined for both zones. A. J. M.

3447. Optical Study of Isothermal and Non-Isothermal Sol → Gel Transformations. W. Heller and E. Vassy. *Comptes Rendus*, 207. *pp.* 157–159, *July* 11, 1938.—The authors submit an experimental proof, based on the behaviour of an aqueous alcoholic thixotropic solution of a dehydrated gelatin, that there is only one method of gel formation, and that different cases such as were distinguished by Heymann [see Abstract 1411 (1936)] only differ in the speeds with which they are produced. H. H. Ho.

3448. Sedimentation Volume and Thixotropy. H. Akamatu. *Chem. Soc. Japan, Bull.* 13. *pp.* 456–462, *June*, 1938.—Measurements were carried out on the sedimentation volume when a powder settled in an organic liquid or solution. A parallelism was found between the large sedimentation volume of the powder and the thixotropic nature of the system. AUTHOR.

3449. Lyophilic Properties of Cellulose Derivatives. K. Kanamaru, T. Takada and K. Maeda. *Kolloid Zeits.* 84. *pp.* 42–50, *July*, 1938.—The ζ-potential and its temporary alteration due to immersion of nitrocellulose of different N content in water, methyl and ethyl alcohol, and the relationship thereto of swelling ability is investigated. The results are again in accordance with the previous formula, etc., of Kanamaru. It is also established that the ζ-potential of nitrocellulose is higher according as the swelling ability of the nitrocellulose is higher for the liquid used for immersion. ζ_∞, *i.e.*, the limiting value of the potential, is lower in value according as the value $\zeta_0-\zeta_\infty$ is greater, or less, *i.e.*, according to the degree of turgesence of the nitrocellulose. The zero point is reached when the nitrocellulose is approximately dissolved. [See Abstracts 2331 and 3334 (1937).] S. G. B.

3450. Hydrophilic Properties of Cellulose. Part VI. K. Kanamaru, A. Shiratori and T. Nakamura. *Kolloid Zeits.* 84. *pp.* 50–62, *July*, 1938.—In order to render the cellulose foil waterproof without damaging its other properties, it is pretreated with a solution of Al salts of high organic acids. Thus the penetration of the hydrophobic softening material is effected into the inner structure of the foil where by means of the hydrophobic carbohydrate linkage the fixation of the soap molecule is effected. The influence of the adsorption of the Al soap on the characteristics of the foil, particularly in regard to water vapour penetration and hygroscopic nature, has been investigated. [For Part V see Abstract 1438 (1937).] S. G. B.

3451. Test of Alternative Structures Proposed for Cellulose. S. T. Gross and G. L. Clark. *Zeits. f. Krist.* 99. 5. *pp.* 357–366, 1938.—A number of oriented cellulose materials have been investigated in an effort to determine whether the unit cell for cellulose proposed by Sauter [see Abstract 4791 (1937)] is more consistent with the X-ray evidence than that originally postulated by Meyer and Mark. A number of patterns have been made of tunicin, bacterial cellulose and valonia ventricosa. All patterns were consistent with the Meyer-Mark unit cell. AUTHORS.

3452. Electrokinetic Properties of Activated Charcoal. H. L. Bennister and A. King. *Chem. Soc., J. pp.* 991–997, *July,* 1938.—Although much work has been published on adsorption by charcoal, little information is available as to the fundamental changes in the electrical condition of the surface, which take place on activation under various conditions. As a result of extensive preliminary work, a standard technique has been developed for obtaining reproducible measurements of the kataphoretic migration velocity of charcoal suspensions by a method using the principle of the ultramicroscope. It is found that equilibrium conditions are set up after 4–5 hours' activation at a given temperature, and that the kataphoretic velocity varies in the same way as adsorptive capacity. Oxygen-activated charcoal is always negatively charged in pure water, there being a pronounced maximum with samples activated at *ca.* 850°. The effect of the concentration of the charcoal suspension on kataphoretic velocity is also studied. AUTHORS.

3453. Electrophoretic Mobility of Tristearin in Presence of Chlorides. D. I. Breese and W. C. M. Lewis. *Faraday Soc., Trans.* 34. *pp.* 787–793, *July,* 1938.—Results are reported for dispersed purified tristearin in solutions of chlorides of Na, Ba, La, Al, and Th at 25° C. and pH = 4. For Na, Ba, La, limiting mobilities without reversal of direction are obtained, for Al a zero value at $1\cdot4\times10^{-3}$ mole/litre. The difference between $LaCl_3$ and $AlCl_3$ is attributed to hydrolysis in the latter case, even at constant pH. When the pH alters (as a result of hydrolysis of $AlCl_3$) the electrophoretic behaviour is markedly different. With $ThCl_4$ the mobility falls to zero at $2\cdot2\times10^{-6}$ mole/litre, even when pH is maintained at 4 in order to repress hydrolysis. The relative discharging effect of $Na^{\cdot}$-, $Ba^{\cdot\cdot}$- and $La^{\cdot\cdot\cdot}$- kations is in good agreement with the Gouy theory, but not that of $Al^{\cdot\cdot\cdot}$- and $Th^{\cdot\cdot\cdot\cdot}$-; in the case of these two, colloidal hydrolytic products probably interfere. Attention is drawn to the increase in electro-kinetic charge density (calculated by Gouy's relation) with increasing electrolyte concentration, this cannot be explained by capillary data, which are necessarily obtained at a liquid-liquid interface. D. R. H.

3454. Crystallisation of Rubber through Pressure. P. A. Thiessen and W. Kirsch. *Naturwiss.* 26. *pp.* 387–390, *June* 17, 1938.—Previous investigation had shown rubber to be a solid-liquid system in which equilibrium was dependent not only on temperature but also markedly on pressure. 1 mm. bands 10 mm. in dia. are prepared by pouring latex over glass plates, and tested in a flexible vacuum-tight metallic tube enclosed axially in a similar wider tube. On evacuation of the annulus a pressure up to 100 atm. can be generated in the inner, and temperature can be held remarkably constant for months on end if proper precautions are taken. X-Ray exposures are taken through a 0·6 mm. stop for 5–20 min., the progress of freezing being shown by increasing definition of the rings. At 4–6° C. all specimens, whether pressed or not, showed rings; at 8° the rings were still weak after 71 days and slowly improved; above 8° the halo persisted for as long as 141 days, whether pressure was applied or not. Structures after 50, 80, 127 days are tabulated, for 7° C. at zero and 10 atm. pressure, for 8° C. at zero and 15 atm. pressure, for 9° C. at zero and 20 atm., and for 10° C. at zero and 25 atm. It is clear that uniform pressure influences the crystallisation, and increases surfusion. The favourable influence of pressure may be due either to enhanced velocity of crystallisation or to promotion of nuclei formation. It is qualitatively established that velocity of crystallisation diminishes with falling temperature. At normal pressure a m.pt. of 20–23° C. for rubber is deduced. D. R. H.

***3455. Ultrasonic Centrifuge. P. Girard and N. Marinesco.** *Comptes Rendus,* 206. *pp.* 2000–2002, *June* 27, 1938.—An apparatus is described in which material to be centrifuged is also submitted to the action of ultrasonic waves, the object being to extract ferments, viruses, and hormones without alteration in composition from cells and tissues at low temperatures. A. J. M.

***3456. Vacuum Type Air-Driven Centrifuge for Biophysical Research. J. W. Beams, F. W. Linke and P. Sommer.** *Rev. Sci. Instruments.* 9 *pp.* 248–252, *Aug.,* 1938.—An improved vacuum type self-balancing centrifuge which is driven by air is described. It is especially suited for spinning rotors larger than 2 inches in diameter at very constant temperatures. Either the "quantity" or "analytical" type of rotor may be used with the same driving mechanism. AUTHORS.

CRYSTAL STRUCTURE AND SPECIAL PROPERTIES.

3457. Twinning and Coalescence in Lattices of Close Packed Spheres. G. Menzer. *Zeits. f. Krist.* 99. 5. *pp.* 378–409, 1938.—The paper is divided into three parts and deals with various lattices built of close packed spheres. In Part I equations are derived for the transformation of the lattice coordinates of the one member of a cubic twin to those of the other member. A quasi-cubic super-lattice appears which is common to both members of the twinned cubes. The ratio of the parameter of this quasi-cubic lattice to that of the individual cube is equal to the order number q of a cubic twin. The equations are applied to all three cubic translation lattices. Part II deals with an extension of these transformation equations to the twinning on the (111) face of cubic lattices and to the coalescence of cubic with hexagonal lattices of close packed spheres. In Part III the author discusses certain defects which appear in the region of contact of two twinned lattices. J. I.

3458. Simplified Derivation of the Laue Particle Size Equation. B. E. Warren. *Zeits. f. Krist.* 99. 5. *pp.* 448–452, 1938.—A simple derivation of the Laue particle size equation is given. The result is compared with the equations of Scherrer and Bragg. AUTHOR.

3459. Diffraction of X-Rays by a Crystal. J. Laval. *Comptes Rendus,* 207. *pp.* 169–170, *July* 11, 1938.—The general problem of the diffracting power of amorphous bodies for X-rays is discussed and some results are given of the measurement of the diffracting power in the particular case of sylvine and MoKα radiation. J. I.

3460. Direct Determination of Crystal Structure from X-Ray Data. M. Avrami. *Phys. Rev.* 54. pp. 300–303, *Aug.* 15, 1938.—The empirical similarity in the behaviour of scattering-factor curves for different atoms is used to replace the structure-factor formulæ by an approximating system. This system is shown to lead to m'th degree algebraic equations, designated fundamental equations, whose coefficients are calculable in terms of crystal structure and atomic scattering factors. The roots of these equations give the coordinates of the unknown atomic positions. Thus if the values of a sufficient number ($2m$ in general;

$m+1$ where there is a centre of symmetry) of sequential structure-factors are known, the problem of direct structure determination is solved. If only the absolute magnitudes are known, one may derive reciprocal equations of the $m(m-1)$th degree whose coefficients are calculable in terms of the squared moduli of the structure factors. We can then write fundamental equations of degree $m(m-1)/2$ whose roots give the coordinates of the interatomic distances from which the unknown parameters themselves may readily be determined. If the number of unknown parameters in any projection is m, the minimum number of structure factor moduli required in this case is $m(m-1)+1$. The method developed in the paper is applied to the KH_2PO_4 crystal, and the results are found to compare very well with the values found by West on the basis of a trial-error and Fourier synthesis investigation. AUTHOR.

3461. Energies of Disorder in Ionic Crystals. W. Jost. *Faraday Soc., Trans.* 34. *pp.* 860–867, *Aug.*, 1938.—The significance and computation of the energies of disorder are discussed. The energies for different types of disorder are compared. The computation of the height of the energy barrier is considered, together with the dependence of the different energies on temperature. [See Abstract 3825 (1938).] F. J. B.

3462. X-Ray Spectrum and Structure of Cu and Ni in Cu-Ni Alloys. J. Farineau and M. Morand. *Comptes Rendus,* 206. *pp.* 1895–1896, *June* 20, 1938.—Examination of intensity-voltage curves for $L\alpha$ of Cu in Cu-Ni alloys containing 40 (constantan) and 25% Ni shows that this line for Cu is not appreciably different from that given by the pure metal, but that the same line for Ni is much narrower. A similar effect to that shown by Ni in this alloy is shown by $L\alpha$ of Cu when some atoms of Cu are replaced by Zn without change in the crystal lattice, *e.g.*, in α-brass. C. A. S.

3463. X-Ray Study of System Ni-P. H. Nowotny and E. Henglein. *Zeits. f. phys. Chem.* 40. *Abt.B.* 4. *pp.* 281–284, 1938.—By means of Debye-Scherrer photographs the authors investigate the structure of Ni-rich alloys in the range 0—35 atom.% P. In addition to phases Ni_3P and Ni_2P, which are isomorphous with the corresponding phases in the Fe-P and Mn-P systems, there are two other phases Ni_5P_2 and Ni_7P_3. Ni_7P_3 probably has a cubic lattice. In the case of Ni_2P good agreement is obtained between the estimated intensities and those calculated on the assumption that the parameters found for Fe and P atoms in Fe_2P also hold for the Ni and P atoms in Ni_2P. J. I.

3464. X-Ray Investigations in the Systems Mn-Bi, Co-Sb, Ni-Sb. U. Fürst and F. Halla. *Zeits. f. phys. Chem.* 40. *Abt.B.* 4. *pp.* 285–307, 1938.—The application of a previously proposed stability criterion for X-ray control of the constitution diagram, is further investigated. (1) In the Mn-Bi system the phase X is found to have a rhombic unit cell with $a = 4 \cdot 30_8$, $b = 5 \cdot 24_5$, $c = 6 \cdot 30_8$ Å, probably Mn_2Bi. The tetragonal cell of γ with $a = 5 \cdot 83_3$, $c = 5 \cdot 35_0$ may be $MnBi_2$. (2) In the system Co-Sb the phase CoSb is found to have the NiAs lattice with $a = 3 \cdot 866$ Å, $c = 5 \cdot 183$; $CoSb_2$ has the marcasite lattice with $a = 3 \cdot 20_8$, $b = 5 \cdot 78_0$, $c = 6 \cdot 41_5$ Å. (3) In the Ni-Sb system the γ phase has NiAs structure; β has a tetragonal unit cell with $a = b = 5 \cdot 78_5$ Å, $c = 6 \cdot 00$, further work is in progress to establish whether this is really Ni_2Sb or Ni_5Sb_2. The cubic δ is an interstitial solid solution of Ni in Ni_3Sb of composition $Ni_{13}Sb_4$. ϵ with rhombic unit cell with $a = 3 \cdot 20_6$ Å, $b = 5 \cdot 63_4$, $c = 6 \cdot 22_8$ shows a marcasite structure. The atomic radii of the elements in question are discussed, with special reference to their dependence on structure. D. R. H.

3465. Submicroscopic Twinning in Nickel. G. Menzer. *Naturwiss.* 26. *pp.* 385–387, *June* 17, 1938.—The author cites anomalous results, obtained by Brück for thin Ni and Ag films condensed on rock-salt, by electron diffraction photographs [see Abstract 2977 (1936)], and the claim of Royer [see Abstract 3261 (1935)] that the lattices of rock-salt ($a = 5 \cdot 628$ Å), Ag ($a = 4 \cdot 08$ Å) and Ni ($a = 3 \cdot 52$ Å) lie parallel. Submicroscopic twinning has previously been postulated to explain the cases of SiC and felspar $KAlSi_3O_8$. Further, Hull [see Abstract 380 (1918)] found a weak body-centred lattice in Ni, and electrolytic Ni or a condensed Ni film may show a hexagonal or tetragonal structure. The author discusses the effect of twinning on a minute scale with (111) planes moved in parallel directions, and concludes that not only the (001) line but also the (002), (004) and (008) maxima must disappear. *New* reflections may appear at ($\frac{1}{3}\,\frac{1}{3}\,\frac{1}{3}$), ($\frac{2}{3}\,\frac{2}{3}\,\frac{2}{3}$), etc., which may simulate an entirely new lattice, and to some extent this may occur even in powder photographs. He considers this phenomenon is sufficient to explain these anomalies, at least in part. D. R. H.

***3466. Lattice Constant of Silver at High Temperatures. W. Hume-Rothery and P. W. Reynolds.** *Roy. Soc., Proc.* 167*A*. *pp.* 25–34, *July* 7, 1938.—A camera for accurate high temperature work, with filings enclosed in a thin-walled SiO_2 capillary, thus avoiding volatilisation from the small quantity of heated metal on to the large area of camera wall *in vacuo*, is described. The special technique for handling such fine tubes is discussed critically. Assuming that the expansion of massive Ag is attributable solely to the lattice expansion, and using Keesom and Jansen's data for the former, the authors find that between −253° C. and 943° C.

$$\log_{10}\left(\frac{a}{a_0}\right) = \frac{c\theta}{\theta_0 - \theta} + x e^{-y\theta},$$

where $a_0 = 0 \cdot 608079$, $c = 4 \cdot 1614 \times 10^{-2}$, $\theta_0 = 5586 \cdot 6$, $x = 0 \cdot 0004898$, $y = 1 \cdot 5208 \times 10^{-2}$. When $\theta = 0$ $da/d\theta = 0$, satisfying the theoretical condition of a zero coefficient at absolute zero. Above 273° K. the second term is less than 0·0001 Å, so that the equation then reduces to a very simple form with only two constants. This simplified equation holds also for quartz. D. R. H.

3467. Structure of Thin Ni and Ag Films. G. Menzer. *Zeits. f. Krist.* 99. 5. *pp.* 5. *pp.* 410–443, 1938.—Brück [see Abstract 2977 (1936)] evaporated Ag and Ni on to the surface of rock-salt crystals and examined by electron diffraction the thin films so obtained. The present author makes an analysis of the photographs and deduces the laws governing the coalescence of the two lattices. He finds that the metal layers do not form a homogeneous lattice with symmetry axes parallel to those of the rock-salt but the adjacent parts of the two lattices form an intersecting lattice. The method by which these lattices are formed is examined. The author makes a similar analysis of photographs obtained by Cochrane [see Abstract 4473 (1936)] of Ni films deposited electrolytically on the (110) face of a Cu single crystal. J. I.

3468. Optical Constants, Electrical Resistance and Structure of Thin Metal Films. J. Krautkrämer. *Ann. d. Physik,* 32. 6. *pp.* 537–576, *July,* 1938.—Electrical resistance and optical constants were determined for thin films of Au and Ag evaporated in high vacuum on to fused silica substrates at various temperatures, whilst the structure and roughness of the films was investigated by electron diffraction at grazing incidence. A comparison of the optical constants of the films deposited at high temperatures with the theoretically calculated values for a loosely built layer of normal metal grains gives good agreement. In the same way, the resistance measurements and especially the roughness determinations support the view that the properties of the investigated films are to be attributed not to an amorphous, but to a colloidal state of the metal, *i.e.*, the films consist of individual but normal crystallites. A. G. Q.

3469. Monotropy of Ice at Atmospheric Pressure (Ice VIII). E. Cohen and C. J. G. van der Horst. *Zeits. f. phys. Chem.* 40. *Abt.B.* 4. *pp.* 231–251, 1938.—By chemical and X-ray methods it is shown that at 1 atm. pressure water may crystallise regularly. The regular crystals are obtained from mixtures of water with organic liquids, especially acetone or propyl aldehyde. The regular modification, to which the name Ice VIII is given, is metastable at 1 atm. pressure. Its density at −30° C. is $0 \cdot 105 \pm 0 \cdot 2$. Dilatometric and optical investigation of naturally occurring ice and of ice formed from water mixed with toluene, decahydronaphthalene and xylene shows the presence of small quantities of a regular form in addition to the hexagonal. L. A. W.

3470. α-β Transformation in Quartz. H. E. v. Steinwehr. *Zeits. f. Krist.* 99. 4. *pp.* 292–313, 1938.—The author describes experiments in which beams of light from the same source are made to pass through a quartz crystal in directions which are respectively perpendicular and parallel to the optic axis. The beams fall on to photographic plates and simultaneous photographs are taken during the $\alpha \rightleftarrows \beta$ transformation over a temperature range of 4° C. The curves on the photographs resulting from the change of temperature show breaks which, the author concludes, prove the existence of two intermediate modifications. These modifications are probably biaxial. J. I.

3471. Variations of Crystalline Parameter of CdO by Insertion of Cd Atoms in its Lattice. R. Faivre and A. Michel. *Comptes Rendus,* 207. *pp.* 159–161, *July* 11, 1938.—An X-ray study has been made of variations in the structure of the products formed when mixtures of CdO and Cd are heated. The experiments indicate the existence of solid solutions in which Cd has been inserted within the oxide lattice. These results should explain the phenomena of O_2 absorption by various oxides such as those of Cd, Zn and Ni, and the anomalies in electrical conductivity which result therefrom. H. H. Ho.

3472. Reciprocal and Bravais Lattices of Axinite. W. F. de Jong. *Zeits. f. Krist.* 99. 4. *pp.* 326–335, 1938.—A spectrometer, described in a previous paper [see Abstract 1412 (1938)] has been constructed, and is now applied to an investigation of axinite. From two photographs the reciprocal lattice of the substance is determined. The elementary cell is $a = 7 \cdot 13$, $b = 8 \cdot 91$, $c = 9 \cdot 14$, $\alpha = 91°51'$, $\beta = 102°52'$, $\gamma = 81°57'$, and the density $3 \cdot 17$ gm. cm^{-3}. The reciprocal lattice is $a' = 8 \cdot 91$ mm., $b' = 6 \cdot 96$ mm., $c' = 6 \cdot 89$ mm., $\lambda = 89°55'$, $\mu = 77°16'$, $\gamma = 97°50'8''$. (Cu Kα radiation.) C. J. B. C.

3473. Polymorphism of MnSe. A. Baroni. *Zeits. f. Krist.* 99. 4. *pp.* 336–339, 1938.—From an electron diffraction study it is established that MnSe may exist in three different forms, as Schnaase has shown for MnS, MnSeα obtained by the ageing of the MnSe precipitated from a sulphate, chloride or acetate solution by $(NH_4)_2$ Se, has an NaCl type of structure, $a - 5\cdot 44$ Å. MnSeβ is prepared by keeping a solution of manganese acetate for some hours in contact with an atmosphere of H_2Se. This modification has a ZnS type of structure with edge $5\cdot 82$ Å. This form passes over into the α-form. MnSeγ is very unstable. It is formed by the action of H_2Se and gaseous ammonia on a boiling $MnCl_2$ or $MnSo_4$ solution. It crystallises with a wurzite lattice, $a = 4\cdot 12$, $c = 6\cdot 72$.

C. J. B. C.

3474. Structure of EuS. W. Nowacki. *Zeits. f. Krist.* 99. 4. *pp.* 339–341, 1938.—The unit cell of EuS, determined by the powder method, is probably face-centred cubic, $a = 5\cdot 957 \pm 0\cdot 002$ Å. It is not possible to give the space group with any certainty but it is probably one of the following, O_h^5–Fm3m, O^3–F43, T_d^2–F43m, T_h^3–F_m^3 or T^2–F23. There are 4 molecules in the unit cell and the density is $5\cdot 884$ gm cm.$^{-3}$. The ionic radius is found to be $1\cdot 24$ Å and the atomic volume $29\cdot 0$.

C. J. B. C.

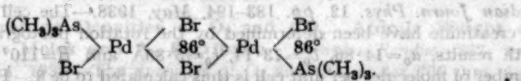
3475. Structure of Bismuth Trioxide. L. G. Sillén. *Arkiv f. Kem. Min. och Geologie, Stockholm,* 12*A*. 18. [15 *pp.*], 1938. *In English.* —Various apparently different phases of Bi_2O_3 were examined with X-rays: α-Bi_2O_3, stable at the ordinary temperature, originally regarded as orthorhombic, is shown to be monoclinic with a $5\cdot 83$, b $8\cdot 14$, c $7\cdot 48$, β $67^\circ\cdot 07$, and $4Bi_2O_3$ in the unit cell, space group probably C_2^1 or C_2^2; β-Bi_2O_3, stable at high temperature, tetragonal (pseudocubic, perhaps truly cubic at high temperature) corresponds with the cubic forms of As_2O_3 and Sb_2O_3, a $5\cdot 525$, with $4Bi_2O_3$ in the unit cell; retention of the cubic structure at low temperature may perhaps be due to contamination with SiO_2; Bi_2O_3 fused with a little Al_2O_3 or Fe_2O_3 gives a body-centred cubic phase with a $10\cdot 08$, and $12Bi_2O_3$ in unit cell space group probably T_3; this phase is, however, perhaps really $12Bi_2O_3 + Me_2O_3$ (Me = Al or Fe); possible structures for both are proposed. C. A. S.

3476. Structure of $CuCl_4\cdot 2NH_3\cdot (NH_4)_2$. A. Silberstein. *Comptes Rendus,* 206. *pp.* 1737–1739, *June* 8, 1938.—Debye-Scherrer photographs are taken of the above compound and from the close similarity between them and photographs of $CuCl_4\cdot 2H_2O\cdot (NH_4)_2$ the author obtains the structure. The cell is tetragonal with the following dimensions $a = b = 7\cdot 74$ Å, $c = 8\cdot 84$ Å., $c/a = 1\cdot 023$; d (calc.) $= 1\cdot 92$, d (obs.) $= 1\cdot 92$. Good agreement is obtained between estimated intensities and those calculated on the assumption that 1/3 of the Cu atoms are arranged regularly in the lattice and the other 2/3 arranged irregularly. [See Abstract 2680 (1938).] J. I.

3477. Structure of Trimethylstibine Dihalides $(CH_3)_3SbX_2$. A. F. Wells. *Zeits. f. Krist.* 99. 5. *pp.* 367–377, 1938.—The structure of the compounds $(CH_3)_3SbX_2$ (where X = Cl, Br or I) is investigated by means of X-rays. They all crystallise in the hexagonal system with the following unit cell dimensions, X = Cl, $a = 7\cdot 27$, $c = 8\cdot 44$ Å; X = Br, $a = 7\cdot 38$, $c = 8\cdot 90$ Å; X = I, $a = 7\cdot 53$, $c = 9\cdot 59$ Å; space group = $C\bar{6}2c$. The following bond distances are evaluated from estimated intensities of reflection, $Sb - Cl = 2\cdot 49$, $Sb - Br = 2\cdot 63$, $Sb - I = 2\cdot 88$ Å. These distances are considerably greater than those found by electron diffraction in the trihalides (SbX_3). The compounds are therefore regarded as being intermediate between (a) the 5-covalent molecule $(CH_3)_3SbX_2$, in which the halogen atoms are symmetrically disposed on opposite sides of a planar $Sb(CH_3)_3$ group, and (b) the ionic form $X^-[Sb(CH_3)_3]^{2+}X^-$.

This interpretation is in accord with the abnormal physical and chemical properties of these compounds. J. I.

3478. Structure of Bridged Palladium Compounds. A. F. Wells. *Roy. Soc., Proc.* 167*A*. *pp*. 169–189, *Aug*. 5, 1938.—The crystal structures of the bridged compounds $[(CH_3)_3As]_2Pd_2Cl_4$ and its Br analogue have been determined. The crystals of the tetrachloride from alcohol and from dioxane and those of the tetrabromide from dioxane are all isomorphous. A probable structure deduced from the optical properties, cell dimensions and symmetry was confirmed by Fourier projections using visually estimated intensities. The structure of the tetrabromide was investigated in detail, the configuration of the molecule being finally obtained from a section of the three-dimensional electron density distribution. The bridged molecule is found to be planar with the configuration :



The interatomic distances are : Pd–Br, 2·45 and Pd–As, 2·50 ± 0·05 Å. The molecules are stacked in columns along 4_2 axes in the space group I 4/*m*, and the columns of molecules are held together by very weak van der Waals forces. The packing of the molecules in this way leaves tunnels through the structure. These remain empty in certain circumstances, as for example when the tetrachloride crystallises from alcohol. On crystallising from dioxane, however, this compound takes up dioxane of crystallisation presumably owing to the fact that the diameter of the dioxane molecules is approximately the same as that of the holes in the structure. The introduction of the solvent is accompanied by a small increase in the cell size and a slight reorientation of the molecules of the Pd compound. AUTHOR.

3479. Structures of 9 : 10-Dihydroanthracene and 9 : 10-Dihydro-1 : 2 : 5 : 6-Dibenzanthracene. J. Iball. *Chem. Soc., J. pp*. 1074–1077, *July*, 1938.—The crystal structures of 9 : 10-dihydroanthracene and 9 : 10-dihydro-1 : 2 : 5 : 6-dibenzanthracene have been investigated by X-rays. The latter compound crystallises in two distinct monoclinic modifications, and in one of them it is possible to demonstrate the presence in the molecule of a centre of symmetry. If it is assumed that the two naphthalene nuclei are planar, it follows that the whole molecule must be planar, as it possesses a centre of symmetry. AUTHOR.

3480. Structure of Diketopiperazine. R. B. Corey. *Am. Chem. Soc., J*. 60. *pp*. 1598–1604, *July*, 1938.—X-Ray examination of crystals of 2,5-diketopiperazine shows them to be built upon a simple monoclinic unit having $a_0 = 5 \cdot 19$ Å, $b_0 = 11 \cdot 50$ Å, $c_0 = 3 \cdot 96$ Å, and $\beta = 83°$, containing two molecules. All atoms are in the general positions of the space group $C_{2}^{5}h - P2_1/a$ with the following parameters : O, $x = 0 \cdot 160$, $y = 0 \cdot 368$, $z = 0 \cdot 885$; C, $x = 0 \cdot 320$, $y = 0 \cdot 430$, $z = 0 \cdot 705$; methylene C, $x = 0 \cdot 545$, $y = 0 \cdot 380$, $z = 0 \cdot 495$; N, $x = 0 \cdot 280$, $y = 0 \cdot 544$, $z = 0 \cdot 695$. The molecule is a nearly flat hexagonal ring possessing a centre of symmetry, the angles between all bonds being 120 ± 3°. The interatomic distances within the molecule are : C-O 1·25 Å, C-C 1·47 Å ; C-N 1·33 Å and N-methylene C 1·41 Å, each ± 0·03 Å. All molecules are held together by H bonds to form long, parallel chains throughout the crystal. Packing of the molecules is discussed. AUTHOR.

3481. Structure of Anthraquinone. B. C. Guha. *Phil. Mag.* 26. *pp.* 213–223, *Aug.*, 1938.—The arrangement of the atoms in the anthraquinone crystal has been determined by the trial and error method. It has been found that the C atoms are all in one plane, and the C plane is tilted from the (001) plane by 6° about each of the "*a*," "*b*," and "*c*" axes. The hexagons deviate slightly from regularity; the side rings have all the internal angles equal to 120°, but the lengths of sides are alternately 1·35 Å and 1·46 Å. For the middle ring the internal angles differ from 120°; the angle between the two single bonds is 109°, and that between a single bond and a double bond is 125°. The C — C bonds are 1·46 Å and the C = C bonds are 1·35 Å, as in the outer rings. The O atoms are inclined to the carbon plane unsymmetrically, the C = O distances being 1·13 Å each. AUTHOR.

3482. Space-Group of Creatinine. K. Banerjee and A. Haque. *Indian Journ. Phys.* 12. *pp.* 183–194, *May*, 1938.—The cell dimensions of creatinine have been determined by the rotation photograph method with results, $a_0=14\cdot86$, $b_0=13\cdot14$, $c_0=5\cdot85$Å and $\beta=110°\ 36'$. The number of molecules per unit cell is thus calculated to be 8. From oscillation photographs it is concluded that no systematic absence of planes occurs and hence the space-group is found to be $C^1_{2h}/P_2/m$. AUTHORS.

3483. Quasi-Crystalline and Crystalline Liquids. F. C. Frank. *Phys. Zeits.* 39. *pp.* 530–534, *July* 1, 1938.—This paper deals with certain difficulties which arise in the attempt to render compatible the theory of quasi-crystalline structure in normal liquids with the existence of true crystalline liquids. It is shown by means of known forces that two non-adjacent molecules can only be parallel when a chain of adjacent parallel molecules lies between. Such a chain can break, continue, or branch at any point, so that it is of fundamental importance for the extension of the parallelism that the relationship of the probabilities of branching and scission be known. If the ratio be less than unity, then the parallelism is limited to a finite region, but if equal to unity then it is unlimited. In this relationship, that varying molecular ratios may produce variable macroscopic transformations, is to be found the solution to many problems in the theory of crystalline structure in liquid phases, especially from the data of the X-ray spectra which indicate that the liquid and liquid crystal forms are almost identical. The consideration of small deviations from parallelism in every chain member, which are reduced in multiple chain compounds, is necessary for the explanation of thermal transformations and other variable transitions by this theory. H. H. Ho.

3484. Effect of Temperature on Atomic Distribution in Liquid Potassium. C. D. Thomas and N. S. Gingrich. *J. Chem. Phys.* 6. *pp.* 411–415, *Aug.*, 1938.—X-ray diffraction patterns of liquid K at temperatures of 70°, 200°, 295° and 395° C. have been obtained, using Mo Kα radiation. Three peaks appear in each pattern, and with increasing temperature the peaks become somewhat less pronounced. The first and most intense peak appears at a scattering angle of 10° 36′ in the 70° C. case, and it appears at 10° 16′ in the 395° C. case. Fourier analysis applied to the above two cases gives the atomic distributions at these temperatures. In the 70° C. distribution curve, the maximum of the first peak occurs at 4·64 Å, that of the second peak at 9·0 Å, and after this the distribution rapidly becomes random. In the 395° C. distribution curve, the maximum of the first peak occurs at 4·8 Å, that of the second at 9·2 Å, and beyond this the distribution becomes random more rapidly than in the 70° C. case. AUTHORS.

3485. Crystallisation of Alkali Halogen Salts on Fluorite. L. Krastanow and I. N. Stranski. *Zeits. f. Krist.* 99. 5. *pp.* 444–448, 1938.—Experiments are described in which halogen salts of the alkali metals are deposited on to the octahedral face of CaF$_2$ crystals. The degree of orientation varies according to whether the lattice constant of the deposited salt is similar or not to that of CaF$_2$ (d=5·47 Å). NaCl (d=5·62 Å) shows very good orientation while KI (d=7·11 Å) shows no orientation. The authors discuss the theory of the crystal growth. J. I.

See also Abstracts 3442, 3451, 3454, 3500, 3678, 3762, 3809, 3810, 3825, 3845, 3847.

DENSITY.

3486. Limiting Densities of O$_2$ and CO$_2$. Atomic Weight of Carbon. E. Moles and A. Escribano. *Comptes Rendus,* 207. *pp.* 66–68, *July* 4, 1938.—The densities of O$_2$ and CO$_2$ under 760 mm. and 380 mm. pressure have been determined by adsorbing known volumes of the gases on activated charcoal and finding the increase in weight. The limiting densities obtained by extrapolation were: O$_2$, 1·427644 gm./l.; CO$_2$, 1·963340 gm./l. This gives 44·0074 for the molecular weight of CO$_2$, and 12·0074 for the atomic weight of C. A. J. M.

3487. Densities of NaCl and KCl Solutions at 0° C. T. Batuecas. *Zeits. f. phys. Chem.* 182. *Abt.A.* 3. *pp.* 167–176, 1938.—Density determination at O° C were made by the author's pyknometer method with a view to investigating the validity of the Marson-Geffcken–Redlich linear relation between the apparent molar volume and the square-root of the concentration. It is confirmed that the relation is linear for solutions of strength 0·5 to 0·2 *N*. In agreement with Geffcken, below 0·2 *N* it was found that there is noticeable curvature which in the lower region has the form of a flat S curve. The experimental method was not suitable for observations below 0·02 *N*. By least square extrapolation to zero, values were found for the molar volumes which are in good agreement with those of Redlich and Rosenfeld. P. H. B.

3488. Density of Solutions of Organic Acids in Benzol, Dioxane and Cyclohexane. G. Schulz. *Zeits. f. phys. Chem.* 40. *Abt.B.* 3. *pp.* 151–157, 1938.—The densities at 20° C of solutions of cinnamic, lauric, benzoic and proprionic acids in benzol and dioxane, and of lauric and proprionic acids in cyclohexane, were determined by sinker weighings. Except in the case of proprionic acid the results were consistent to within 0·00001. The density-concentration curves are however not smooth but show slight local deformations. From a comparison of the curves it is concluded that the solvents play an important part in the formation of "solution-complexes". P. H. B.

3489. Densities of D$_2$O and H$_2$O. Electrolytic Separation of Oxygen Isotopes. L. Tronstad and J. Brun. *Faraday Soc., Trans.* 34. *pp.* 766–773, *June,* 1938.—100% D$_2$O and 100% H$_2$O of the same oxygen isotopic ratio as in air have been prepared by the reaction of 100% D$_2$ and H$_2$, made by electrolysis of large quantities of 99·5% heavy water and of natural water, with copper oxide. Precision determinations of the density at 20° C. referred to ordinary water of the same temperature give the figures: For D$_2$O: d^{20}_{20} = 1·10726 ± 0·00001, for H$_2$O: d^{20}_{20} = 0·999980 ± 1 p.p.m. These values correspond to a molecular abundance of D_2O in natural water of : 1 : 5960 ± 300, or by weight : 1 : 5360 ± 270. Attention is drawn to the application of the 100% H_2O free from D_2 and of the same O^{18}/O^{16}-ratio as in air, as a reference substance in accurate work. The electrolytic separation factor of the oxygen isotopes is found to be $\alpha = 1{\cdot}036$. The amount of O^{18} in the commercial heavy water from Norsk Hydro-Elektrisk Kvælstof A/S corresponds to 0·32% D_2O^{18}. Authors.

3490. Density of Tap-Water from Osaka, Japan, and Cambridge, U.S.A. T. Titani and N. Morita. *Chem. Soc. Japan, Bull.* 13. *pp.* 409–418, *June,* 1938. *In German.*—Comparisons were made between the densities of purified tap-water from Osaka (Japan) and Cambridge (U.S.A.) by means of sinker weighings. Repeat determinations on the Osaka water were consistent to $\pm 1 \times 10^{-7}$ gm./ml. and the results agreed with those for the Cambridge water to $\pm 2 \times 10^{-7}$ gm./ml. In comparing the results account was taken of isotopic fractionation by distillation and of the effect of dissolved air. P. H. B.

3491. Isotopic Ratio in Ordinary Water. N. Morita and T. Titani. *Chem. Soc. Japan, Bull.* 13. *pp.* 419–426, *June,* 1938. *In German.*—The D content of Osaka and Cambridge (U.S.A.) tap-water were determined by the production of D-free water. Water from both sources gave the same result, namely D : H = 6200 ± 200. These values are compared with other published data, including the authors' earlier result [see Abstract 3977 (1936)]. P. H. B.

See also Abstract 3443.

DIFFUSION AND OSMOSIS.

3492. Diffusion in Metals. P. Chevenard and A. Portevin. *Comptes Rendus,* 207. *pp.* 71–73, *July* 4, 1938.—A review of methods, direct and indirect, of investigating metallic diffusion. A. J. M.

3493. Hydrogen Penetration Through Mercury. J. Nikliborc. *Acta Physica Polonica,* 7. 1. *pp.* 34–44, 1938. *In German.*—The mechanism of H_2 penetration through a column of Hg during the glow discharge between Hg electrodes in a mixture of Hg vapour and H_2 has been studied by an optical and by an electrolytic method. The penetration occurs principally by volume diffusion and the diffusion velocity is considerably influenced by convection currents in the liquid Hg and by the type of heating. The process involves essentially solution of HgH formed during the discharge. W. R. A.

3494. Separation of Gaseous Mixtures by Diffusion. E. H. Riesenfeld and T. L. Chang. *Arkiv f. Kem. Min. och Geologie, Stockholm,* 12*A*. 19. [8 *pp.*] 1938. *In German.*—The separation of a CO_2-O_2 mixture by diffusion in a Hertz apparatus using porous tubes has been investigated. With increasing concentration of the heavy component the separation factor decreased. There is a logarithmic connection between the separation factor and the concentration of CO_2. These results are discussed on the basis of the adsorption of the gases on the porous material. A. J. M.

3495. Self-Diffusion in Solids. G. Hevesy. *Faraday Soc., Trans.* 34. *pp.* 841–845 ; *Disc.,* 849–850, *Aug.,* 1938.—A review of the application of the isotopic indicator method to the investigation of self-diffusion in metals and solid electrolytes. A. J. M.

3496. Self-Diffusion Coefficient of Gold. H. A. C. McKay. *Faraday Soc., Trans.* 34. *pp.* 845–849 ; *Disc.,* 849–850, *Aug.,* 1938.—

The self-diffusion coefficient D of Au has been determined by finding at various temperatures the distribution of radioactive Au atoms in a disc of the metal after heating, the active atoms being originally more concentrated on one side of the disc than the other. The radioactive Au atoms were produced by bombardment of the disc with neutrons. The curve of log D against 1/T is linear. The connection between D and T is given by log $D = 4 \cdot 1 - 1 \cdot 1 \times 10^4 \times 1/T$ (D in mm.^{2} per min.) corresponding to a " heat of activation " of 51,000 cal. A. J. M.

3497. Osmosis. E. Ernst and J. Koczkás. *Zeits. f. Physik*, 109. 9–10. *pp.* 625–641, 1938.—The authors claim to show both theoretically and experimentally that osmotic phenomena cannot be explained from a consideration of the kinetics of the dissolved substance (the non-permeable part of the solution), but are connected with the vapour pressure difference which the solvent (the permeable part) exhibits on the two sides of the membrane. From this standpoint, the conclusion is drawn (and experimentally verified) that in an osmotic system which on both sides of the membrane consists of solutions of equal concentration but at different temperatures—and in contrast to the deductions of classical theory—the solvent on the warmer side can flow to the colder solvent and thereby dilute it. From a consideration of this liquid transport—which is opposed to the concentration gradient produced by the thermal difference—there is offered a possibility of elucidating water phenomena in biological systems which hitherto have defied explanation. H. H. Ho.

See also Abstract 3791.

ELASTICITY AND PLASTICITY.

3498. Parallel Plate Calculations. C. V. Brigatti. *Ricerche di Ingegneria*, 6. *pp.* 42–47, *March–April*, 1938.—The method of H. Marcus is applied for the calculation of elastic plates with the form of a parallelogram supported and uniformly loaded. The results obtained are extended in particular to the rhombic plate for which is also calculated the case of the perfect dovetail with uniformly distributed load. J. J. S.

3499. Direct Determination of Stresses from Stress Equations. B. Sen. *Phil. Mag.* 26. *pp.* 98–119, *July*, 1938.—Problems of plane deformation have been solved without the help of Airy's stress function. The solution of corresponding plane stress problems can be deduced by substituting $(1+\sigma)^{-1}$ for $(1-\sigma)$ in the results obtained. The knowledge of the displacement is found to be unessential except in some special cases where the stresses cannot be directly determined from the stress equations, but where the complete solution is obtained on making the displacement single-valued with the addition of extra terms. The method now given has the advantage that the prescribed boundary values of the stresses being known, the stresses can easily be determined in most cases from the stress equations. H. H. Ho.

3500. Variation of Elastic Constants of Crystalline Sodium with Temperature Between 80° K and 210° K. S. L. Quimby and S. Siegel. *Phys. Rev.* 54. *pp.* 293–299, *Aug.* 15, 1938.—Methods are described for growing single crystals of Na in the form of rods 4·7 mm. in dia. and 10 cm. long, for handling the crystals in an atmosphere of He, and for measuring the principal elastic moduli at low temperatures. Values of the adiabatic and isothermal moduli and constants are tabulated at ten degree intervals between 80° K. and 210° K. The value of the

Debye characteristic temperature, calculated from the values of the elastic constants at 80° K, is 164° K. AUTHORS.

3501. Elastic Effect in Vulcanised Rubber. W. Braunbek. *Zeits. f. Physik,* 109. 7–8. *pp.* 510–516, 1938.—In the theory of elasticity Hooke's law is only a first approximation, the terms of second and higher orders being neglected. A consideration of terms of the second order demands the introduction of a new elastic constant (the " *s* " of Poynting). Torsional measurements on loaded rubber tubing give a constant (C) of the order of 10^{-1}, a value which is about 10 times smaller than in metals; thus, under identical conditions, the lengthening of a rubber tube under torsion is smaller than in metals. The value of C depends to a large degree on the nature of the rubber. H. J. H. S.

3502. Optical Method for the Determination of Variable Elastic Stresses. B. Ferretti. *N. Cimento,* 15. *pp.* 77–87, *Feb.,* 1938.—It is shown that the sum of the principal stresses in a plane lamina can be determined experimentally for any material by photoelastic measurements in the general case when the stresses are varying with time. A photoelastic method for measuring rapidly variable stresses is described which gives both the values and the directions of the stresses from instant to instant. The method is applied to the case of a plate of glass subjected to a sudden blow. W. S. S.

***3503. Elastic After-Effect. Part II. Schlötzer.** *Zeits. f. Instrumentenk.* 58. *pp.* 264–270, *July,* 1938.—Continuing the experimental investigation on elastic after-effect by means of two clock springs [see Abstract 4334 (1937)], it is found that if the same springs are subjected to special mechanical or electrical ageing treatment after a large change of tension takes place, the elastic after-effect is reduced to less than half that which occurs when no artificial ageing is applied. H. B.

3504. Mechanical and Thermal Treatment of Synthetic Resins. S. Erk and W. Holzmüller. *Phys. Zeits.* 39. *pp.* 535–540, *July* 15, 1938. *From the Reichsanstalt.*—The hardness of synthetic resins is measured by a ball indentation hardness tester and it is found that considerable plastic deformation is induced by the ball, the size of the indentation becoming less after the load is removed. Mechanical and optical tests show that when the ball impression is formed internal strains are induced which may be removed by heating at temperatures up to about 100° C. At higher temperatures there is a continuous softening for some synthetic resins but in the case of others an increase of hardness sets in at temperatures higher than 160°–250° C. J. T.

See also Abstracts **3442, 3523, 3563, 3604, 3859,** *and*

2584B. Internal Shearing Stress in Cold-Twisted Metallic Bars. T. Uéda.
2588B. Photoelastic Analysis. O. J. Horger.
2589B. Phenolformaldehyde as Photoelastic Material. A. Kuske.

GRAVITATION.

3505. Thickness of the Isostatic Earth's Crust. C. Tsuboi. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 285–287, *June,* 1938. *In English.*—Using a double Fourier series for the surface topography of the area in question, and the Bouguer anomalies in this area, an expression is obtained for the depth, *d*, at which the load of the surface mass is compensated. The value of *d* can be calculated directly from surface gravities and topographies. To get the thickness of the isostatic earth's crust, which corresponds to zero height, the thickness of the mass compensating the constant term of the topography must be subtracted from *d*. Tests show satisfactory results from the method. R. S. R.

See also Abstract 3540.

HYDRODYNAMICS AND AERODYNAMICS.

***3506. Non-Static Problems in Hydrodynamics. G. Krall.** *Ricerca Scientifica*, 9. *pp*. 445–474, *May*, 1938.—The paper deals with wing problems, including vibrating and beating wings and questions of critical velocity. In an appendix a new design for a wind tunnel, adapted for the study of oscillating wings and for the recovery of the vortices of Prandtl and Birnbaum, is described. W. A. R.

3507. Air Movements with Very Low Reynolds Numbers. J. Luneau. *Comptes Rendus*, 206. *pp*. 1788–1790, *June* 13, 1938.—Having already in a preceding investigation [see Abstract 1026 (1937)] considered air resistance for high Reynolds numbers, the author has now investigated the effect of low numbers. The coefficient of resistance becomes inversely proportional to these numbers, and the resistance to movement proportional to the amplitude. W. A. R.

3508. Efficiency of Air-Screws. R. Esnault-Pelterie. *Comptes Rendus*, 207. *pp*. 13–17, *July* 4, 1938.—The author discriminates between the coefficient of kinematic utilisation and the aerodynamic efficiency of an air-screw, and points out that under certain conditions it would appear to be advantageous to increase the number of blades on the air-screw. J. S. G. T.

3509. Propagation of Hydraulic Waves. G. Krall. *Accad. Lincei, Atti*, 27. *pp*. 348–356, *April* 3, 1938.—This paper deals mathematically with the propagation of waves and the transmission of energy in a hydraulic system. The following cases are considered in some detail: when the various pipes forming the system meet in a common node and the compression begins in one of them and is reflected at the ends of the others; a single pipe, the compression beginning at one end, the other end being closed by a vibrating system; the pipe along which the compression travels is of various characteristics—varying diameter—the compression being started at one end and the other end leading into a large reservoir; the pipe, constant in diameter, has a large reservoir or capacity part way along its length, at one end the compression originates and the end leads into another reservoir. G. G.

3510. Equations of Probable Values of Turbulent Fluids. G. Dedebant and P. Wehrle. *Comptes Rendus*, 206. *pp*. 1790–1792, *June* 13, 1938.—The author arrives at a generalisation of classical hydrodynamical theory of viscous fluids by the introduction of turbulent energy analogous to the generalisation of rational mechanics by the introduction of calorific energy. W. A. R.

3511. Velocity and Temperature Distributions in the Turbulent Wake behind a Heated Body of Revolution. A. A. Hall and G. S. Hislop. *Cambridge Phil. Soc., Proc*. 34. *pp*. 345–350, *July*, 1938.—Recently [see Abstract 954 (1938)] Goldstein made calculations based on theories of vorticity transfer, of the distributions of velocity and temperature in the turbulent wake behind a heated body of revolution, and the present authors now record an experimental determination of these distributions in a low-turbulence wind tunnel. Difficulty was experienced in obtaining a truly symmetrical wake, and observations have been reduced to mean values, curves of which are given. [See following Abstract.] H. H. Ho.

3512. Velocity and Temperature Distributions behind a Heated Body of Revolution. S. Goldstein. *Cambridge Phil. Soc., Proc.* 34. *pp.* 351–353, *July,* 1938.—The measurements of Hall and Hislop [see preceding Abstract] are compared with the results of a mathematical analysis, and the theoretical curves on the momentum transfer theory and on the modified vorticity transfer theory are found to be practically identical over the inner part of the wake. They are not in agreement in the outer parts of the wake, but here it was known that the theory must lead to incorrect results. It is concluded that though Kármán's "similarity" theory may lead to an equation of the same form as either the momentum or the vorticity transfer theories with symmetrical turbulence, it cannot lead to an equation of the same form as the modified vorticity transfer theory and therefore must give unsatisfactory results in a symmetrical wake. H. H. Ho.

3513. Stability of a Viscous Liquid between Rotating Coaxial Cylinders. J. L. Synge. *Roy. Soc., Proc.* 167*A. pp.* 250–256, *Aug.* 5, 1938.—The differential equations of the characteristic-value problem for the small disturbance of a viscous liquid contained between two rotating coaxial cylinders are put into convenient form. From these is deduced an expression for the real part of the characteristic number σ occurring in an exponential time factor, the expression involving integrals in which the integrands contain the product of a characteristic function or one of its derivatives by the complex conjugate. If the circulation at the outer cylinder is greater than that at the inner cylinder and has the same sign $(\omega_2 r_2^2 > \omega_1 r_1^2 > 0)$, the signs of these integrals are known without knowledge of the characteristic functions, and it is found that the steady motion is stable under the condition stated. Unlike the work of G. I. Taylor on this problem, the present theory involves no approximations based on the thinness of the layer of liquid, but (as in Taylor's work) the only disturbances considered are those which are independent of the azimuthal angle and periodic in the direction of the generators of the cylinders. AUTHOR.

3514. Experimental Realisation of Solid Boundaries Free from Limiting Layer. A. Toussaint and M. Gdaliahu. *Comptes Rendus,* 207. *pp.* 117–118, *July* 11, 1938.—The presence of a limiting layer at the solid boundary of a conduit in which fluid flows is avoided by making the boundary wall of perforated iron sheet covered with permeable silk. Air or other fluid is aspirated through the silk. J. S. G. T.

3515. Hydraulic Régime when a Solid is Translated through a Viscous Liquid. R. Serville. *Comptes Rendus,* 206. *pp.* 1947–1948, *June* 27, 1938.—A crystal of fuchsine is attached to a solid which is then allowed to fall freely in a stream of water. Below the critical velocity the dye is discharged in parallel lines; with higher velocities disturbances occur which can be classified into four types. W. A. R.

3516. Pressure Losses for Fluid Flow in 90° Pipe Bends. K. H. Beij. *Bureau of Standards, J. of Research,* 21. *pp.* 1–18, *July,* 1938.—Pressure losses were determined for nine 4-in. steel, 90° pipe bends of radii from 6 to 80 in. The results are discussed in relation to those found by previous investigators under comparable test conditions. For bends having radii of four pipe diameters or less, all the results which are discussed may be correlated on the basis of pipe roughness. Further data are needed to establish a working formula. No correlation could be obtained for the bends of larger radii. For such bends the maximum published values should be used in engineering work until more comprehensive data become available. AUTHOR.

See also Abstracts 3536, 3764, 3765.

KINETIC THEORY OF MATTER.

3517. Kinetic Processes in Boundary Surfaces. K. Neumann. *Zeits. f. Elektrochem.* 44. *pp.* 474–478, *Aug.*, 1938.—The uniform distribution of a solute in a solution is brought about by diffusion processes, and in analogous manner the concentration equilibrium in single adsorption layers is produced and maintained by kinetic processes the mechanism of which forms the subject of the present paper. The spreading of liquid surface films on a liquid substratum, *e.g.*, oil on water, is first considered at length, and the rapid rates of solution of such substances as camphor and water or benzophenone and mercury are ascribed to the rapid movements of the surface molecules. The significance of surface kinetics for condensation and evaporation processes at solid bodies is next discussed in detail. Finally the movements of polar molecules on ionic lattices are examined. 5 diagrams and 13 references are included in the papers. H. H. Ho.

3518. Relativistic Degenerate Gas and its Application to Brownian Motion. M. Satô. *Tôhoku Univ., Sci. Reports*, 11. *pp.* 429–432, *April*, 1938. *In German.*—In a previous paper [see Abstract 2545 (1936)] the author has theoretically investigated the Brownian movement of a particle in a radiation field, whereby the particle is assumed to receive an impulse-charge by the irregular impacts of light quanta. This theory is now supplemented by a discussion of the Einstein fundamental conception of impulse-fluctuation within empty space radiation; the physical significance of the photo-cause of the Brownian movement is thereby explained. H. H. Ho.

See also Abstracts 3497, 3779.

LENGTH, AREA AND VOLUME.

See Abstract 3579.

MATHEMATICAL METHODS AND THEORY OF MEASUREMENTS.

3519. Effect of Departures from Ideal Conditions other than Non-Normality on the t and z Tests of Significance. H. E. Daniels. *Cambridge Phil. Soc., Proc.* 34. *pp.* 321–328, *July*, 1938.—It is shown that slight departures from independence and equal weight of the sample observations introduce a bias into Fisher's z, but that the distributions of the variances " within and between groups ", and of Fisher's z would appear to maintain their form to the first order, although the extent to which the approximations hold in practice has not been considered. AUTHOR.

3520. Fluctuations and the Shot Effect. E. N. Rowland. *Cambridge Phil. Soc., Proc.* 34. *pp.* 329–334, *July*, 1938.—In view of a criticism [see Abstract 4956 (1937)] of a proof and extension of Campbell's theorem on fluctuations previously reported [see Abstract 495 (1937)], certain parts of the proof are amplified and further explanations of the foundations of the theory are given. N. M. B.

3521. Short Derivation of a Fundamental Probability Formula. L. Silberstein. *Phil. Mag.* 26. *pp.* 223–224, *Aug.*, 1938.

3522. Dimensions in Continuum Physics. R. Fürth. *Ann. d. Physik*, 32. 4. *pp.* 336–346, *June*, 1938.—For continuum physics it is assumed that there exists a "homogeneous body," *i.e.*, one possessing no structure. The physical behaviour of such a body is expressed by differential equations between the observable physical magnitudes, the coordinates and the time; yet in these certain "material constants" are still contained, which for each body composed of the same material must have the same value independent of its form and magnitude. The question arises whether such a system can be employed as expression of a continuum theory, *i.e.*, whether the therein contained material constants indicate a homogeneous body or whether for the understanding of the phenomena which are observed a hidden spatial or temporal structure must be assumed. These and similar questions are discussed, the views of various authors being mentioned, and the different departments of physics severally considered. In particular Zöcher's theory which is described as a "pseudo-continuum theory" is dealt with. Zöcher brought forward his theory in connection with the elastic behaviour of liquid crystals. The author himself prefers a dimension criterium which he explains in the paper. J. J. S.

See also Abstracts **3535, 3579, 3778, 3832, 3881.**

MECHANICS, CLASSICAL.

3523. Mechanics of Elastic Bodies. C. Cattaneo. *Accad. Lincei, Atti*, 27. *pp.* 342–348, *April* 3, 1938.—This paper deals with the local stresses set up in a small zone around the region of contact when two elastic bodies collide, the collision being an oblique one. The effect of friction is taken into consideration. Comparatively simple equations are obtained for the distribution of the stresses in the case where the bodies are of the same material. These equations will give a first approximation, using modified constants of course, even in the case where the two bodies are made of different materials. G. G.

3524. Flight of Projectile. R. H. Kent. *Frank. Inst., J.* 226. *pp.* 19–23, *July*, 1938.—A popular review of the internal and external ballistics of the flight of a projectile from gun to target. The review gives all the latest results and methods of measurement in a simple manner. S. G. B.

***3525. Dissipation of Energy by a Pendulum Swinging in Air. E. C. Atkinson.** *Phys. Soc., Proc.* 50. *pp.* 721–741; *Disc.*, 753–756 *and* 856–857, *Sept.* 1, 1938.—The decrement of a pendulum falls slowly with the amplitude: hence the need for determinations based on small changes of angle. The resulting errors of observation lead to erratic values but not to systematic error. The result of measurements with a seconds pendulum enclosed in a case is shown by a smoothed curve, the departure from observed times being expressed by *smoothing fractions*, and a *smoothing figure* is a measure of this departure for the whole or part of the experiment. From the decrement the rate of loss of energy is calculated. This 7 kg. pendulum with amplitude 53′ dissipates a Board of Trade Unit (which serves a 70 W. lamp for 14 hr.) in rather over 100,000 years. Experiments with different pendulums are described by which the component losses due to suspension, rod, and bob are found. Suspension springs made from thin strip clamped in chaps dissipate large and variable amounts of energy compared with springs made from thick strip ground thin in the middle. The variable losses are associated with variable rates of the pendulum. The cylindrical case adds considerably to the air resistance. The measured loss due to a gravity impulse lever is little in excess of the computed loss from collision with the pendulum: for a seconds pendulum 1/2000 part of the free pendulum loss. AUTHOR.

***3526. Amplitude Deviation of Rate of a Pendulum. E. C. Atkinson.** *Phys. Soc., Proc.* 50. *pp.* 742–756, *Sept.* 1, 1938.—In a previous experiment [see Abstract 3030 (1936)] the amplitude deviation was almost equal to the circular deviation. The present experiment was made on a lighter pendulum with a long suspension spring, moving in different surroundings. The amplitudes ranged from 108′ to 224′ as compared with the previous range of 30′ to 70′. The deviation is about 15% larger than the circular deviation and is well represented by the latter plus a linear term. Two other experiments with Graham's escapement are referred to, in which the driving weights are varied. One of these, described by Cunynghame, seems to be hypothetical, for it yields an amplitude giving a minimum rate instead of a maximum one. Guillaume overlooked the large temperature effect produced by an invar suspension spring, which the author found by experience and calculated. Sampson sought to find the deviation by observations on a Shortt clock without allowing for impulse deviation. It is pointed out that the deviation for the master pendulum when it is impulsed is less than the deviation for the pendulum when it is free. In addition to the vibration used for time-keeping, a spring-suspended pendulum has a parasitic mode of vibration which the concentrated Shortt impulse is well adapted to set up. Sampson has analysed the author's previous experiment by the method of least squares and concludes that the solution given is but one of a number of possible solutions. Neither of Sampson's alternatives is a least-squares solution and both involve impossible values of the decrement. The corrected normal equations confirm the original solution. AUTHOR.

3527. Modernised Version of Gibbs' Use of the Grand Canonical Ensemble. R. H. Fowler. *Cambridge Phil. Soc., Proc.* 34. *pp.* 382–391, *July*, 1938.—The method of the grand canonical ensemble, as developed by Gibbs, is outlined and a number of formulæ that are important for its use are derived. Its use is illustrated by applying it to a classical gas and to a crystal. R. P.

See also Abstract 3544.

MECHANICS, QUANTUM.

3528. Eulerian Parameters and Lorentz Transformations. H. S. S. Rao. *Indian Acad. Sci., Proc.* 7*A*. *pp.* 339–342, *May*, 1938.—The Cayley-Klein parameters, as used in the theory of top motion, were recently extended [see Abstract 5223 (1937)] to the problem of four-dimensional rotations. In this paper is considered a similar procedure for the Eulerian parameters (another of the quantities used in the theory of top motion), and it is shown that in this case the generalisation to four dimensions is more natural, and that similar relationships to the spinor calculus arising from Dirac's relativistic theory of the electron also exist. N. M. B.

3529. Dirac's Equations in Riemannian Metric Space. W. Benedictus. *Comptes Rendus*, 206. *pp.* 1951–1953, *June* 27, 1938.—This mathematical treatment, developing an expression for the equations, introduces the invariant derivative for spinors without using the notion of parallel displacement or assuming the existence of orthogonal congruences. N. M. B.

3530. Interpretation of Quantum Theory. A. Landé. *Frank. Inst., J.* 226. *pp.* 83–98, *July,* 1938.—The view is expressed that the relation of the notions of waves and particles, as used by quantum theory, are more complicated than they are taken to be in the commonly accepted interpretation of quantum mechanics, and in particular that the wave intensity does not measure directly the probability of finding a particle in a particular position. R. P.

3531. Determination of Eigenvalues. P. Urban. *Ann. d. Physik,* 32. 5. *pp.* 471–488, *July,* 1938.—A mathematical method for determining the eigenvalues of Schrödinger's equation in certain cases is developed, which is completely equivalent with Schrödinger's perturbation method. The method is applied to the problem of the spherical pendulum and a power series for its eigenvalues is obtained. R. P.

3532. Theory of the Neutral Particle. W. H. Furry. *Phys. Rev.* 54. *pp.* 56–67, *July* 1, 1938.—A method due to Majorana of eliminating the states of negative energy in Dirac's wave equation is elaborated and formulated without special reference to a particular set of Dirac matrices. The method cannot be generalised to account for the effect of external electric or magnetic fields, but it can be made to work for a non-electric scalar field. Although the negative states are avoided from the beginning, the theory meets with the same difficulties and singularities as the usual theory of positive and negative electrons. R. P.

3533. Energies Associated with the Two-Centre Problem. Part I. General Features of the Energy Surface. E. Monroe. *Cambridge Phil. Soc., Proc.* 34. *pp.* 375–381, *July,* 1938.—A scheme is presented to show the limiting behaviour of the electronic energy levels in the diatomic one-electron problem for unequal centres, as the ions are separated. This generalises the well known order of levels in the hydrogen molecule ion. Certain implications of the result for the properties of asymmetric diatomic molecules are briefly discussed. AUTHOR.

3534. Completely Relativistic Wave Mechanics. L. Chadenson. *Comptes Rendus,* 207. *pp.* 213–215, *July* 18, 1938.—The author points out that his modification of the Dirac quantum theory [see Abstract 3488 (1936)] has the advantage of disposing of the states of negative energy. G. C. McV.

See also Abstracts 3437, 3583, 3779, 3816, 3832.

PHILOSOPHY OF SCIENTIFIC METHOD.

3535. Application of Statistical Methods to Manufacturing Problems. W. A. Shewhart. *Frank. Inst., J.* 226. *pp.* 163–186, *Aug.,* 1938.—The application of statistical methods in mass production makes possible the most efficient use of raw materials and manufacturing processes, effects economies in production, and makes possible the highest economic standards of quality for the manufactured goods used by all of us. The story of the application, however, is of much broader interest. The economic control of quality of manufactured goods is perhaps the simplest type of scientific control. Recent studies in this field throw light on such broad questions as : How far can Man go in controlling his physical environment? How does this depend upon the human factor of intelligence and how upon the element of chance? AUTHOR.

See also Abstract 3522.

PRESSURE.

***3536. Measurement of Pressures upon a Body Rotating in the Air. E. Brun.** *Comptes Rendus*, 206. *pp.* 1876–1877, *June* 20, 1938.—The difficulty of securing an air-tight joint between the tube transmitting the pressure from the point of the body at which the pressure is to be measured and the manometer is overcome by taking readings of pressure on a manometer rotating with the body. A device for doing this is briefly explained. J. S. G. T.

***3537. Precision Oil Manometer. T. C. Chadwick and S. Palkin.** *Indust. and Engin. Chem.* (*Analytical Edition*), 10. *pp.* 399–400, *July* 15, 1938.—The manometer is a simplified form of the double U-tube type manometer previously described. It is, in effect, a single U-tube type, and requires no backing liquid such as was used in the more complicated form. A detailed drawing of the construction is given, and the method of preparation for use is fully described. S. W.

***3538. Vacuum Seal. W. E. Bahls.** *Trans. A.I.E.E.* 57. *pp.* 373–378, *July*, 1938.—A new type of lead-in structure for vacuum-, gas-, or oil-tight chambers is described in which porcelain bushings are sealed to metal by means of a glass which serves as a bonding agency. The method of assembly is extremely simple, requiring no skilled workmen or elaborate equipment. Some of the features and some of the places where the seal is being applied are discussed. AUTHOR.

***3539. Vacuum Relay. C. W. Miller.** *Journ. Sci. Instruments*, 15. *pp.* 263–265, *Aug.*, 1938.—An arrangement is described whereby a Pirani gauge may be used in an a.c. control circuit to open or close an external circuit when the pressure in a vacuum system exceeds any given value. The performance of such a device is given. AUTHOR.

See also Abstract 3770.

RELATIVITY AND ETHER.

3540. Reduction of Einstein's Gravitational Equations to the Normal Form. A. Finzi. *Accad. Lincei, Atti*, 27. *pp.* 324–330, *April* 3, 1938.—It is shown that Einstein's gravitational equations can be reduced to the normal form if instead of the usual coordinates isometric coordinates are introduced. L. K.

3541. Experimental Study of the Rate of a Moving Atomic Clock. H. E. Ives and G. R. Stilwell. *J.O.S.A.* 28. *pp.* 215–226, *July*, 1938.—The displacement of the centre of gravity of the Doppler lines in and against the motion of the H particles in a canal-ray beam with respect to the undisplaced lines is given by $\lambda=\lambda_0\ (1-V^2/c^2)^{1/2}$ where V is the velocity of the particles [see Abstracts 4864 (1937)] and 481 (1938)]. A tube similar to Dempster's and a grating of dispersion 10Å/mm. were used. The observed shifts are compared with the values calculated from the measured voltages and from the observed total Doppler displacement. The agreement is good and gives positive evidence for the Larmor-Lorentz theory. The weakness of the work lies in the fact that the separation of the components of H, the line used, is greater than the observed shift (0·01 to 0·047Å). H. G. C.

See also Abstract 3580.

SOLUTION.

See Abstract 3757.

SURFACE PROPERTIES.

3542. Sorption of Vapours by Cellulose and Derivatives. K. Kanamaru and J. Chao. *Kolloid Zeits.* 84. *pp.* 85–99, *July,* 1938.—The sorption isotherms of various cellulose preparations and their derivatives for vapours of various organic liquids have been determined. The isotherms are considered in relation to the form of the preparation (powdered granular, thread, etc.) and the physical properties, especially dielectric constant of the liquids and adsorbents. In comparison with other forms films of cellulose and cellulose derivatives have a smaller capacity for sorption of vapours of relatively low vapour pressure, and a higher capacity for those with higher vapour pressures. A. J. M.

3543. Activation of Charcoal by ZnCl$_2$. G. G. Kandilarow. *Kolloid-Beihefte,* 48. 1–3. *pp.* 1–32, 1938.—A review of the processes involved in the activation of charcoal is given, and experiments on the preparation of activated charcoal by the carbonisation of cellulose treated with ZnCl$_2$ are described. ZnCl$_2$ increases the activity of the charcoal by removing impurities and thus increasing the area of active surface, and by facilitating the formation of a disordered arrangement of C atoms. The best method of preparing activated charcoal using ZnCl$_2$ embodying these results is described. A. J. M.

3544. Theory of Cooperative Phenomena. G. S. Rushbrooke. *Cambridge Phil. Soc., Proc.* 34. *pp.* 424–428, *July,* 1938.—The statistical theory of adsorption is worked out on the assumption that the heat of adsorption varies linearly with the fraction of surface already covered, and that the adsorbed molecules can perform vibrations with a frequency that again varies linearly with the covered surface. In general the change in the adsorption isotherms is only quantitative, but if the dependence of the vibration frequency on the adsorbed amount is very large it is possible to obtain critical conditions *above* a certain critical temperature, rather than below a certain temperature as in the usual conditions. R. P.

3545. Statistical Theory of Adsorption. Part I. F. Cernuschi. *Cambridge Phil. Soc., Proc.* 34. *pp.* 392–398, *July,* 1938.—The adsorption of atoms in two layers is studied for the following two simplified models: (1) The interaction between the atoms in each layer is neglected, but it is assumed that a second-layer atom can be attached wherever four neighbouring first-layer atoms form a square; (2) the effect of the interaction within each layer is taken into account in a crude way. Both these calculations lead to the possibility of critical phenomena. R. P.

3546. Properties of Mobile and Immobile Adsorbed Films. J. K. Roberts. *Cambridge Phil. Soc., Proc.* 34. *pp.* 399–411, *July,* 1938.—The essential difference between mobile and immobile adsorbed films of gases on solids when there is repulsive interaction between adsorbed particles is discussed. Ordinary statistical methods can be applied to the equilibrium configurations of the particles in a mobile film but not to immobile films. Films formed by the adsorption of diatomic molecules with dissociation are then considered. It is pointed out that for a mobile (equilibrium) film there are differences between the true heat of adsorption and the apparent heat obtained from the temperature variation of the evaporation rate. A detailed comparison is made by obtaining a formula for the apparent heat of evaporation and comparing it with that for the true heat obtained earlier by Wang [see Abstract 2868 (1937)] and the physical reasons for the differences are discussed. A model suitable for studying the pseudo-equilibrium states in immobile films is described and formulæ and diagrams in connection with the kinetics of the formation of such films and the variation of heat of adsorption with fraction of surface covered are given. [See following Abstract.] AUTHOR.

3547. Kinetics of Adsorption with Long-Range Interaction between Adsorbed Particles. J. S. Wang. *Cambridge Phil. Soc., Proc.* 34. *pp.* 412–423, *July*, 1938.—The rates of condensation and evaporation of adsorbed particles when they interact with long-range forces are deduced from kinetic considerations, including also the case of adsorption of diatomic molecules with dissociation. The rate of evaporation is compared with experiment, and the variation of the dipole moment with θ required to make the theory agree with experiment is discussed. Finally the formulæ for the rates of condensation and evaporation are applied to the problem of the diffusion of gases through metals, and it is found that for the processes considered the effect of interaction does not alter the conclusion arrived at in an earlier paper [see Abstract 46 (1937)] concerning the diffusion equation at small p and at large p. [See preceding Abstract.] AUTHOR.

3548. Adsorption. P. Harteck. *Zeits. f. Elektrochem.* 44. *pp.* 468–473, *Aug.*, 1938.—This subject is reviewed under the headings: (1) Van der Waals' adsorption and adsorption produced by polar forces (which lead in the vicinity of the saturation pressure of the adsorbent to capillary condensation. (2) Activated Adsorption: (*a*) Reversible, (*b*) Irreversible (Chemisorption). The dependence of adsorption processes on temperature and pressure, the velocity with which the adsorption equilibrium is regulated, and the processes of separating individual gases from mixtures almost quantitatively, are dealt with for various adsorbents: For theoretical study, smooth surfaces are the best to investigate. Adsorption proceeds in general without heat of activation and the amounts of gas adsorbed rise with falling temperature. Recently, however, cases of adsorption have been found which do not decline with rising temperature but indicate an activated adsorption. Experiments with para H_2 and D_2 have permitted further insight into the nature of adsorption. Adsorption processes at high temperatures should throw light upon the mechanism of catalysis. The paper is illustrated by 5 diagrams. H. H. Ho.

3549. Differential Method for the Measurement of Small Amounts of Adsorbed Gases. W. Hunsmann. *Zeits. f. Elektrochem.* 44. *pp.* 540–542, *Aug.*, 1938.—A differential volumetric process has been devised, and a suitable apparatus designed, in order to construct isotherms at higher temperatures for the measurement of the duration of adsorption according to the method of Langmuir. Full details with diagrams are included for measurements of the superficial adsorption of ethane at oxidised Ni foil. H. H. Ho.

3550. Heats of Adsorption of Alkalis by Standard Cellulose. J. L. Morrison, W. B. Campbell and O. Maass. *Canad. J. of Research*, 16. *Sect. B. pp.* 195–202, *June*, 1938.—The heats of adsorption of aqueous NaOH, KOH and LiOH and some salt solutions by cotton cellulose have been measured. The adsorption of alkali by cellulose seems to be ionic rather than molecular; more particularly, it appears to be closely related to the availability of the H^+ ion from the very weakly acid cellulose, and of the OH^- ion from the electrolyte. AUTHORS.

3551. New Method of Measuring Surface Tension of Liquids. V. Naggiar. *Comptes Rendus*, 206. *pp.* 1882–1884, *June* 20, 1938.—A drop of liquid is suspended in a small circular hole cut in a thin metal plate. Measurements of the radii of curvature of the surfaces of the drop, together with its thickness, determine the surface tension. Only a few mg. of liquid are required and it is unnecessary to know the angle of contact. An accuracy of *ca.* 1% is claimed. G. C. E.

3552. Fine Structure of Boundary Surfaces. T. Schoon. *Zeits. f. Elektrochem.* 44. *pp.* 498–507, *Aug.*, 1938.—This subject is discussed under the following headings: (*a*) Theoretical Study of the Atomic Arrangements in the Solid Surfaces of Crystals. (*b*) Theories with respect to Atomic Distances and Electric Fields in Boundary Surfaces. (*c*) Experimental Methods. Of the methods examined, that of electron diffraction has proved to be the most fruitful, and its limitations and difficulties are discussed. (*d*) Expansion or Contraction of the Lattice Distances. Experiments are described which indicate that for crystals with ionic unions the lattice surfaces contract, whereas for crystals with covalent bonds expansion occurs in accordance with theoretical requirements. (*e*) Degrees of Surface Roughness. (*f*) Material Composition of the Surface Layer. (*g*) Surface Fields of Force. The changes in chemical properties which accompany group or atom changes in the surface are discussed for the fatty acids and their salts, and also for zinc blende. The electron diffraction data for MgO, Al_2O_3 and graphite are also briefly considered. The paper includes 16 diagrams. H. H. Ho.

3553. Relationships between Parachor Values and the Physical Constants of Homologous Series. D. T. Lewis. *Chem. Soc., J. pp.* 1056–1061, *July*, 1938.—Relationships are put forward connecting the parachor values with the critical temperatures and boiling points of substances in homologous series. The silico-paraffins obey a relation having the same numerical constants as the corresponding hydrocarbons. Associated substances such as the alcohols and acids do not obey these relations. By utilising these generalisations certain doubtful atomic parachors have been calculated, and various physical constants predicted. The connection between these relations and the co-volume factor of the van der Waals equation is discussed, the parachor being regarded as a true comparative measure of molecular volume. AUTHOR.

3554. Large-Scale Representation of Monomolecular Films. H. Devaux and L. Pallu. *Comptes Rendus*, 206. *pp.* 1693–1695, *June* 8, 1938.—Most of the properties of monomolecular films can be reproduced on a macroscopic scale by means of discrete particles floating on a Hg surface. P. H. B.

3555. Monomolecular Layers. R. Brill. *Zeits. f. Elektrochem.* 44. *pp.* 459–468, *Aug.*, 1938.—This very comprehensive paper, which is illustrated by 9 diagrams, deals with the subject under 4 headings, *viz.*, (1) The preparation of monomolecular layers. (2) Measurement of the spreading-pressure and the states of aggregation thereby found for such layers. (3) The influence of ions at great dilution. (4) Preparation of synthetic films and their principal properties. H. H. Ho.

3556. Mechanical Properties of Films and Stability of Foams. P. A. Rehbinder and A. A. Trapeznikov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 7. *pp.* 423–426, 1938. *In English.*—Attempts to measure the surface viscosity of sodium oleate solution by means of a horizontal oscillating disc [see Abstract 1493 (1938)] failed to show any such viscosity. That of such solutions of concentration $c = 1\cdot05\text{–}0\cdot03\%$, was, however, measured (I) within 2 days of preparation, and (II) after 50 days ageing, by determining the logarithmic decrement (λ) of the oscillation of a ring (5·39 cm. dia.) of Pt wire (1 mm. thick) oscillating within a fixed similar concentric ring 6·12 cm. dia., both being horizontal in the surface of the solution. λ is plotted against c. In both curves λ shows a maximum for $\lambda = 0\cdot045$, but the whole curve for (II) lies well below that for (I). The stability of the foam formed by such solutions was also determined after intervals of 30 sec. to 22 hr. from time of preparation, and plotted against c. The stability decreases with lapse of time, and after 22 hr. shows a distinct maximum for $c = 0\cdot04\%$ approximately. [See following Abstract.] C. A. S.

3557. Stabilising Effect of Adsorption Layers and Their Mechanical Properties. A. A. Trapeznikov and P. A. Rehbinder. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 7. *pp.* 427–430, 1938. *In English.*—The stabilising action of adsorption layers as functions of their surface concentrations was investigated by determining the life of bubbles at the surface of water (or 0·01-*N*-HCl) covered with films of an insoluble acid (lauric, myristic, palmitic and oleic were used), alcohol or ester. Results are shown by curves, and generally indicate a maximum effect for a smaller area per molecule than that obtained by previous investigators. [See Abstract 1395 (1931) and preceding Abstract.] C. A. S.

3558. Mercury-Solution Boundary Layers of Organic Substances. A. Gorodezkaya and A. Frumkin. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 9. *pp.* 639–643, 1938. *In English.*—The examination of thin layers on the surface of Hg in solutions of electrolytes affords the possibility of studying the influence of the electric field upon the properties of the layer. Moreover, at this boundary it is possible to obtain thin polylayers, since a drop of organic acid spreads completely over the surface of the Hg electrode polarised to the potential corresponding to the maximum of the electrocapillary curve. A new method is now described for the study of thin layers at this boundary, based on the fact that the capacity of the double electrical layer of a metallic electrode, in the case of the penetration of organic molecules into that double layer, ought to be considerably reduced. The method of capacity measurements used does not differ essentially from that of Borissowa and Proskurnin [see Abstract 4348 (1936)]. The paper deals with measurements of electrode capacity with constant surface, films of cetyl alcohol and palmitic and oleic acid being employed, and also when the Hg surface is compressed. H. H. Ho.

3559. Investigation of Surface Phenomena by Radioactive Methods. O. Hahn. *Zeits. f. Elektrochem.* 44. *pp.* 497–498, *Aug.*, 1938. —A brief review of radioactive methods and of substances employed is given, and it is pointed out that radio-active gaseous substances (*e.g.*, thoron) are most suitable for the study of inner boundary surfaces and their changes (by the emanation method). Recent investigations on the thermal behaviour of iron oxide hydrogel have indicated that relaxation phenomena can occur according to the mode of water release, which depend on the mode of preparation of the gel, and which can be voluntarily produced or avoided. It has been shown that a spontaneous decline of active boundary surface need not be accompanied by a corresponding increase of primary particles (formation of secondary particles without noticeable recrystallisation). The emanation method used for crystallised salts has established the occurrence of thermal relaxation and recrystallisation of alkaline earth carbonates as dependent on grain size and degree of purity. H. H. Ho.

See also Abstracts 3452, 3467, 3468, 3517, 3566, 3760, 3787, 3829, 3830, and 2576 & 2577B. Lubrication. M. Muskat and F. Morgan.

TIME.

***3560. New Schuler Clock. H. Gockel and M. Schuler.** *Zeits. f. Physik*, 109. 7–8. *pp.* 433–458, 1938.—The clock is fitted with a self impulsing system in place of the auxiliary clock used in earlier models. It is claimed that temperature, amplitude and impulsing errors are so small that changes of rate are less than a few thousandths of 1 sec. a day. The pendulum is not more sensitive to shock than any other ordinary pendulum. The knife-edge suspension has proved itself satisfactory according to measurements extending over three years. On comparing the new Schuler clock with one of the earlier type, it was found that changes in the differential rate, of the order of 0·01 sec./day, occurred every few days. These changes appear to coincide with similar changes in the Shortt clock which serves as the source of the Rugby time signals, so earth tremors are probably responsible, though in what manner, it is difficult to say. P. H. B.

***3561. Quartz Clock. L. Essen.** *Roy. Astron. Soc., Occasional Notes, No.* 1. *pp.* 7–12, *June*, 1938.—A brief explanation is given of the principles involved in the construction of a quartz clock. The performance of the clock, as compared with the pendulum clock, is discussed. The paper concludes with a short account of the quartz clock at the National Physical Laboratory. [See Abstract 2189 (1938).] L. E.

***3562. Centrifugal Carry-Over Device for Synchronous Clocks. H. Bock.** *Zeits. f. Instrumentenk.* 58. *pp.* 261–264, *July*, 1938.—A theoretical investigation of the dynamics of the centrifugal arrangement described by Jarry in *Annales françaises de Chronometrie*, 1937, *Nr.* 3, by means of which short current-less intervals in the feed of synchronous clocks can be bridged over. The arrangement is found to be very satisfactory theoretically, and worthy of more widespread use. P. H. B.

See also Abstracts 3525, 3526, 3573, 3579.

VISCOSITY AND FRICTION.

3563. Rates of Displacement in Viscous Bodies under Applied Stress. R. W. Douglas. *Soc. Glass. Technol., J.* 22. *pp.* 206–213, *June*, 1938.—The analogy which exists between the slow steady motion of a viscous body and elastic displacements has been used to derive the equations for the rates of distortion of heated glass cylinders under pressure. The calculations have been verified experimentally. AUTHOR.

3564. Dependence of Viscosity of Fluids on Molecular Volume, and Application of Principle of Continuity of State. D. T. Lewis. *Chem. Soc., J. pp.* 1061–1066, *July*, 1938.—The viscosities of gases are shown to depend on the molecular weight and the molecular cross-sectional area, as predicted mathematically by Chapman. The derived parachor equation is shown to account satisfactorily for the behaviour of fluids in general, and is applied to many liquids, a generalisation emphasising the importance of the principle of the continuity of state. Andrade's equation for the variation of the viscosity of a simple substance with temperature is shown to follow directly from the general equation, and the connection between the constants of this equation and the molecular weight and volume is demonstrated. AUTHOR.

3565. Viscosity of Air, Oxygen and Nitrogen. P. J. Rigden. *Phil. Mag.* 25. *pp.* 961–981, *June,* 1938. *Supplement.*—The paper describes improvements to Bond's apparatus for the measurement of viscosity [see Abstract 2448 (1937)] and the results obtained. The important improvements were the use of Apiezon "A" in place of light paraffin in the U-tube and the enclosure of the apparatus to protect it from local temperature fluctuations. Details are given of the checks made on the various correction factors and of the complete experimental procedure. The final value for the viscosity of air at 23° C. is $(1830{\cdot}3_4 \pm 0{\cdot}6_9) \times 10^{-7}$ c.g.s. and this value substituted in Millikan's data on e gives a value $4{\cdot}800 \times 10^{-10}$ e.s.u. which is in good agreement with that recently deduced by v. Friesen [see Abstract 2892 (1937)]. The values obtained for O_2 and N_2 and the temperature coefficients are O_2, $(2010{\cdot}5 \pm 0{\cdot}9) \times 10^{-7}$ c.g.s. Temp. coefficient $6{\cdot}23 \times 10^{-7}$; N_2, $(1738{\cdot}2 \pm 0{\cdot}7_3) \times 10^{-7}$ c.g.s. Temp. coefficient $4{\cdot}76 \times 10^{-7}$. F. S. B.

***3566. Influence of Surface Tension on Viscosity Measurement. Viscosity of Methanol. G. Jones and H. J. Fornwalt.** *Am. Chem. Soc., J.* 60. *pp.* 1683–1692, *July,* 1938.—It is demonstrated by mathematical analysis and by experiments on methanol and water that surface tension effects may influence the measurement of viscosity with the Ostwald viscometer. A method of computing the error due to surface tension for an instrument of known dimensions is given. The viscosity of methanol at 25° relative to that of water is 0·6084. The principles of design of the Ostwald viscometer to give high precision without unnecessary sacrifice of convenience and speed in operation are discussed. AUTHORS.

3567. Viscosity of Liquid and Gaseous Propane. B. H. Sage and W. N. Lacey. *Indust. and Engin. Chem.* 30. *pp.* 829–834, *July,* 1938.—The effect of pressure upon the viscosity of liquid and gaseous propane has been determined at five temperatures between 100° and 220° F. The work includes measurements throughout the superheated gas region and the condensed liquid region at pressures up to 2000 lb./in^2. AUTHORS.

***3568. Viscosity of Liquid Helium. W. H. Keesom and G. E. Macwood.** *K. Onnes Lab., Leiden, Comm. No.* 254*a. Physica,* 5. *pp.* 737–744, *Aug.,* 1938. *In English.*—An apparatus for the measurement of the viscosity of liquids and gases, interchangeably, is described. Measurements of the viscosity of liquid He made with this apparatus are reported. The measurements were made over the temperature range from 1·2 to 4·0° K. AUTHORS.

3569. Viscosity of Hydrogen Vapour. W. H. Keesom and G. E. Macwood. *K. Onnes Lab., Leiden, Comm. No.* 254*c. Physica,* 5. *pp.* 749–752, *Aug.,* 1938. *In English.*—Measurements of the viscosity of the saturated vapour of liquid H_2 from 14·5 to 20·3° K. are reported. AUTHORS.

3570. Theory of Oscillating Disc Method of Measuring Viscosity and Slip of Fluids. Part II. G. E. Macwood. *K. Onnes Lab., Leiden, Comm. No.* 84*c. Physica,* 5. *pp.* 763–768, *Aug.,* 1938. *In English.*—A calculation is given of the correction to be applied to the viscosity as determined by oscillating disc apparatus which allows for the inertia and viscosity of the exterior fluid previously neglected. It is found that for large disc separations the correction may be large, while for small separations it is usually negligible. [See Abstract 2316 (1938) and following Abstract.] AUTHOR.

3571. Viscosity of Liquid Hydrogen. W. H. Keesom and G. E. Macwood. *K. Onnes Lab., Leiden, Comm. No.* 254*b*. *Physica,* 5. *pp.* 745–748, *Aug.*, 1938. *In English.*—An experimental verification is given of the corrections (see preceding Abstract) for viscosities determined by the oscillating disc method. The viscosity of liquid H_2 in the temperature range from 14·8° to 20·0° K. is reported. AUTHORS.

See also Abstract 3443.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT.

***3572. Tolerances Permissible in Flats for Autocollimation Tests. C. R. Burch.** *Roy. Astron. Soc., M.N.* 98. *pp.* 670–672, *June,* 1938.—Limits are obtained for the tolerance of spherical convexity or concavity permissible in a flat used for autocollimation. Only the focal ratio of the system and its offence against the sine condition are involved; the determination of the "coefficient of offence" by knife-edge measurements is described. AUTHOR.

***3573. Induction Brake Control for an Astronomical Drive. C. S. Venkateswaran.** *Journ. Sci. Instruments,* 15. *pp.* 265–267, *Aug.*, 1938.—A fine control for astronomical driving clocks, based upon the principle of electromagnetic induction, is described. AUTHOR.

COMETS AND METEORS.

3574. Structure of the Violet Bands of Cyanogen in Cometary Spectra. J. Dufay. *Comptes Rendus,* 206. *pp.* 1948–1951, *June* 27, 1938.—It is shown that the phenomena occurring in the CN spectra of the comets can be explained by the hypothesis that the energy of rotation increases with decreasing distance from the sun. The spectra of five comets taken since 1936 are used to demonstrate this relation. The interval $\Delta\lambda$ between the two principal maxima of intensity (P and R branch) is about twice as great in the spectrum of the comet Wilck as in the spectrum of the comet Whipple while their solar distances have the ratio 0·75/1·80. L. K.

3575. Physics of Meteoric Phenomena. M. A. R. Khan. *Current Science,* 12. *pp.* 635–636, *June,* 1938.—A brief account of the observed phenomena of meteors, with special reference to the trails left behind them, followed by a brief account of the theories suggested to account for them. C. A. S.

COSMOGONY.

3576. Origin of Satellites. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 98. *pp.* 633–645, *June,* 1938.—The masses of the primitive planets must have been comparable with those of the great planets, the terrestrial planets being far too small to have condensed from stellar material. The search for the origin of satellites leads to the consideration of a single planet, extraneous agencies having been shown to be unsuitable for generating satellites. Rotational instability must be involved to produce any disruption of a single mass, but this process produces two bodies of comparable though necessarily different mass. If Jupiter and Saturn are regarded as the masses resulting from such a catastrophic disruption of a single primitive planet, it must be assumed that the avulsion endowed Saturn with sufficient velocity to escape from Jupiter. A filament of material would stream out between the departing components, and the end portions adjacent to the planet would be captured and possibly give rise to satellites. The intervening portions of the filament would go to neither planet and accordingly themselves become independent planets; the terrestrial planets must be relegated to some such origin as this, if their difference of composition is to be explained, and the existence of the Moon may also find an explanation in this same disruption. AUTHOR.

3577. Origin of Binary Stars. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 98. *pp.* 646–650, *June*, 1938.—The pear-shaped series of configurations of a rotating mass of liquid is not only secularly unstable, but also ordinarily unstable, and this indicates that the fission of a body takes the form of the radial ejection of a portion of the mass. Considerations of the subsequent motion of the two components leads to the view that they must be endowed with sufficient energy to escape from each other, otherwise a collision would occur and cause them temporarily to reunite. If this interpretation of fission is correct the origin of binary stars by fission must be forfeited, and any deductions from it relating to the time-scale. AUTHOR.

3578. Evolution of Eclipsing Binaries. Z. Kopal. *Roy. Astron. Soc., M.N.* 98. *pp.* 651–657, *June*, 1938.—The main subject of the present paper is to investigate from the point of view of the fission theory whether the empirical relation between the radii-ratio and the separation of components in eclipsing binary systems, shown in the diagram and fulfilled remarkably well by nearly two hundred eclipsing systems, can be interpreted as an evolution from close to wide pairs. It is found that the general features agree exactly with the expectations of the fission theory; but in order that the observed increase of dimensions may be possible, the eclipsing systems must have far larger stores of angular momenta in the rotation of their components than the amount calculated from the assumption that they rotate with constant Keplerian angular velocities throughout. A rapid increase of the angular velocity inwards would account for this, and is therefore strongly suggested; but so long as we have no definite idea about the structure of stellar configurations, the observational results do not lend themselves to quantitative conclusions. AUTHOR.

3579. Empirical Cosmology. P. Jordan. *Naturwiss.* 26. *pp.* 417–421, *July* 1, 1938.—In continuation of his work [see Abstract 3906 (1937)] on the relation of the fundamental physical constants to cosmology, the author gives an account of the elementary processes involved in the measurement of length and of time in Euclidean and Riemannian geometry. The significance of the Hubble effect in relation to the stability of the universe is discussed, as is also the fundamental relation which states that the ratio of the mass of the universe to that of the proton is equal to the square of the radius of the universe expressed in elementary units e^2/mc^2. This latter leads to a discussion of the ages of the spiral nebulæ, and it is deduced that the constant of gravitation should decrease in inverse proportion to the age of the universe. The various cosmological time-scales which have been proposed are analysed from the physical point of view, and the reactions on cosmological theory both of recent astronomical discoveries and of the new concepts of physics are considered in general terms. A. Hu.

3580. Electrodynamics and Cosmology. H. Mandel. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 8. *pp.* 543–547, 1938. *In German.*—The generalised non-linear electrodynamics proposed by Born in classical (i.e. non-quantised) form is given a geometrical basis in terms of 5-dimensional unified field-theory. A study of Born's tensor F_{ik} leads to a knowledge of the cosmological properties of 5-dimensional space, with especial reference to its curvature on certain assumptions. A. Hu.

3581. Spatial Distribution of Spiral Nebulæ in Milne's Universe. W. Fricke. *Zeits. f. Astrophysik*, 16. 1–2. *pp.* 11–20, 1938.—The author shows that the figures given by Hubble for the nebulæ, are compatible with a plane expanding universe provided the relation between the brightness of the nebulæ and the red shift is taken to be $\Delta \simeq 2\cdot 9 \frac{d\lambda}{\lambda}$. This means that the effective temperature of the nebulæ is 7500° K., and the age of the universe $1\cdot 82 \times 10^9$ years. The density distribution of the nebulæ is calculated on Milne's gravitational theory. The mean mass of a nebula is also calculated under these assumptions, but the resulting value $m_0 = 1\cdot 50 \times 10^{12} \odot$ is much higher than can be expected. A modification of the gravitational theory is suggested. [See following Abstract.] L. K.

3582. Kinematical Theory, Curved Space and the Distribution of Nebulæ. G. C. McVittie. *Zeits. f. Astrophysik*, 16. 1–2. *pp.* 21–28, 1938. *In English.*—Fricke's contention [see preceding Abstract] that Hubble's nebular counts can be satisfactorily interpreted in terms of Milne's kinematical theory in flat space is shown to depend on an inexact use of the theoretical relation between red-shift δ and apparent photographic magnitude m. If the δ, m formula is used correct to the second order in δ, a direct appeal to Hubble's five counts and to the two Harvard counts shows that a close fit for the observations is obtained only by the use of curved space. The corrections to m due to red-shift are investigated and it is also shown that the average density of matter in the inner metagalactic system is of the order of 10^{-29} gm./cm.^{3} [See also Abstract 510 (1938).] AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

3583. Wave Theory in Celestial Mechanics. P. Chadenson. *Comptes Rendus*, 207. *pp.* 119–121, *July* 11, 1938.—A relativity theory is advanced in which the fundamental element ds^2 possesses by definition all the spatial and gravitational properties of the Einstein ds^2. Instead of assuming a 4-dimensional space and working out its consequences, a simplified law of gravitation is taken and the corresponding Riemannian space sought. The law chosen is analogous to the electromagnetic laws in that it is derived from Newton's law as the latter are from Coulomb's law. This law is assumed to hold on the atomic scale, and thence a quantum constant not of action but of dimensions L^2T^{-1} is derived. The quantum conditions and in particular the orbital dimensions not involving the mass of the planetary electron, the Schrödinger-Dirac transformation is applied in the case of the solar system. By appropriate choice of quantum number, fairly accurate values for the radii of the planetary orbits are obtained. The theory is also successful with the satellites of the major planets. A. Hu.

3584. Restricted Three-Body Problem. N. Rein. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 1–2. *pp.* 37–40, 1938. *In French.*—Formulæ are developed from which the period in a closed trajectory obeying the conditions of the problem can be evaluated whether the case is one of direct or of retrograde synodic motion. Where the trajectory is not exactly known, but the interior and exterior lines of an annulus containing it can be defined, a method is given for finding upper and lower limits to the period. The development of the subject is traced from the general case of a body moving in the gravitational field of two finite masses in relative motion, through the particular case to which the Jacobi integral relates, to the restricted circular problem and thence to the more general case of motion in Kepler ellipses. The difficulty, in the elliptical problem, of our ignorance of a first integral analogous to Jacobi's is overcome by introducing a modified scheme for which such an integral exists. The simplified scheme of Fatou, employing Gaussian annular rings, is not altogether satisfactory. The author suggests one in which the attraction of the central masses is replaced by that of material rings whose dimensions are proportional to the eccentricity of the elliptical orbits, and along which the attracting matter is distributed proportionally to the time spent in each element of the orbit. A. Hu.

NEBULÆ.

3585. Photographic Photometry of the Elliptical Nebulæ. (Second Paper). R. O. Redman and E. G. Shirley. *Roy. Astron. Soc., M.N.* 98. *pp.* 613–623, *June*, 1938.—In continuation of work already published [see Abstract 3071 (1936)], the distribution of surface brightness has been measured along the principal axes of nine elliptical nebulæ. The amount of instrumental and other distortion has been determined by measuring focal star images, and it is shown that the errors in the surface brightness should be well under 0·1 in log I, except at distances less than 0′·1 from the centre of the nebula. The surface luminosities have been integrated on the assumption of elliptical isophotal contours, an approximation which has been checked and found sufficiently accurate. Integrated luminosities were reduced to stellar magnitudes by comparison with extra-focal images of standard stars. The results are on the average $0^{m}\cdot 6$ brighter than the values of the Shapley-Ames catalogue. It is noted that the axis ratio of the isophotal contours does not in general remain perfectly constant throughout each nebula, while the visual estimates of Heidelberg and Harvard catalogues appear to give ellipticities systematically too great, a fact of importance in connection with the supposed excess of elongated nebulæ in the sky. AUTHORS.

See also Abstracts 3581, 3582.

PLANETS.

3586. Minor Planet Hermes. H. Spencer Jones. *Roy. Astron. Soc., Occasional Notes, No.* 1. *pp.* 3–6, *June*, 1938.—Images of the asteroid

(1937 UB: Hermes), discovered on Oct. 28 by Reinmuth, were also found on plates of Oct. 25, 26, 27, 28, 29, but not found on Oct. 30, when at its nearest to the earth, for it then moved through 6 hr. of R.A. in the course of 24 hr., its apparent magnitude being then (probably) 6·6. Cunningham gives its nearest approach to the earth as on Oct. 30·5, and as 485,000 miles; the least distance between their orbits being 22,000 miles and the inclination of the two orbits, 6°; its period is 2·1217 yr. and eccentricity is (doubtfully), 0·626. The diameter of Hermes is less than a mile. A diagram is given of the orbit in relation to those of the four inner major planets. A. S. D. M.

See also Abstract 3576.

STARS.

3587. Distribution of Absolute Magnitudes in the Vicinity of the Sun. W. J. Luyten. *Roy. Astron. Soc., M.N.* 98. *pp.* 677–680. *June,* 1938.—The stars with proper motions larger than $0''\cdot 5$ annually which were obtained from the Bruce Proper Motion Survey in the Southern Hemisphere have been used to derive the luminosity function. The formula for mean parallax and the dispersion of the true parallaxes around the mean have been obtained from trigonometric parallax material. The resulting luminosity curve shows a maximum around photographic absolute magnitude + 15 and appears to possess a steeper descent than rise. The total mass in the vicinity of the sun is estimated at 0·08 sun per cubic parsec. AUTHOR.

3588. Method of Deriving Constants of Velocity Ellipsoid From Observed Radial Speeds of Stars. W. M. Smart and S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 98. *pp.* 658–663, *June,* 1938.—A method is developed, based on Schwarzschild's hypothesis, for the determination of the constants of the velocity ellipsoid (with two equal axes) from the observed radial *speeds* of the stars. AUTHORS.

3589. Spectrophotometric Investigations of δ Cephei Stars. Part V. (RT Aurigæ). W. Becker and W. Strohmeier. *Zeits. f. Astrophysik,* 16. 1–2. *pp.* 1–10, 1938.—From the monochromatic brightness differences between RT Aur. and the comparison star HD 47152 (A0) two gradients are formed the long-wave one of which (635 to 480 mμ) has an amplitude of 0·63 and the short-wave one (480 to 400 mμ) an amplitude of 0·72. Light curves deduced for wave-lengths 557, 478 and 410 mμ have amplitudes $0^{m}\cdot 74$, $0^{m}\cdot 95$ and $1^{m}\cdot 22$ respectively. The colour indices for 557 and 410 mμ have amplitudes $0^{m}\cdot 48$ which become $0^{m}\cdot 44$ after reduction to eliminate absorption. The maxima of the short-wave gradient and the observed colour index curve occur $0^{d}\cdot 08$ in advance of that of the light curve. The earliest spectral type (A 8·5) occurs $0^{d}\cdot 15$ after the maximum of the light curve and the latest type (G 0·2) is reached $0^{d}\cdot 15$ before the minimum. The gradient differences for the same spectral type and for the same brightness are determined for both the increasing and the decreasing parts of the curves. [For Part IV see Abstract 1904 (1938).] J. E. K.

3590. Non-Coherent Formation of Absorption Lines. R. v. d. R. Woolley. *Roy. Astron. Soc., M.N.* 98. *pp.* 624–632, *June,* 1938.—A solution of the problem of the non-coherent formation of an absorption line, *i.e.,* formation of an absorption line in the presence of redistribution of frequency, has been attempted by a method of successive approximation. The main result is the appearance of a strong quasi-collision term in the wings of a weak line. It is suggested that non-coherence is chiefly of importance in centre to limb problems. AUTHOR.

3591. Chemical Composition and Dynamical Stability of Stars. L. Biermann. *Zeits. f. Astrophysik*, 16. 1–2. *pp.* 29–42, 1938.—It is shown that the condition for dynamical stability of a star can be put in the form $I/\psi < 3/2(kT/\psi)$, where I is the ionisation energy per free particle and ψ the limiting binding energy at which all electrons are removed by ionisation. The quantity I/ψ is evaluated as a function of ψ for different values of the hydrogen content X, and for several mixtures of the heavier elements. For $X = 0$, I/ψ is approximately 0·2 for $\psi = 500$ to 2000 eV, and is still bigger for $\psi = 60$ to 500 eV. Giants and supergiants, in whose interiors ψ/kT lies between 10 and 15, are therefore dynamically unstable with $X = 0$. With greater H content the value of I/ψ falls; it is 0·07 for $X = \frac{1}{2}$, $\psi = 500$ to 2000 eV. With a constitution of this kind, dynamical stability in such stars is possible. The author points out that the method gives a lower limit to the H content in stars where uncertainty of mass makes the mass-luminosity relation useless.
A. Hu.

3592. Rate of Stellar Radiation. C. H. Collie. *Zeits. f. Astrophysik*, 16. 3. *pp.* 161–166, 1938. *In English.*—It is shown by an appeal to statistical mechanics that neutrons will not be produced in stars by thermal dissociation of heavy elements unless temperatures of 10^9 K. are reached. If neutrons are present then they will cause a large hitherto undetected transport of energy across the stellar boundary by neutrinos. It is shown that this would explain an anomaly in the rate of stellar radiation pointed out by Nernst [see Abstract 1104 (1936)]. AUTHOR.

3593. Relation of Electron Gas Pressure to Radiation Pressure in Degeneracy and Non-Degeneracy. D. S. Kothari and B. N. Singh. *Zeits. f. Astrophysik*, 16. 3. *p.* 200, 1938. *In English.*—Corrections to the original [see Abstract 1910 (1938)].

3594. Compton Scattering of Radiation in a Star. A. B. Severny. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 1–2. *pp.* 45–48, 1938. *In English.*—The absorption of radiation due to Compton scattering by free electrons of stellar matter is calculated for the case that a central region of a star radiates photons of the energy $h\nu \gg m_0c^2$. This region is surrounded by matter of the temperature $kT \ll m_0c^2$, and the free-electrons obey the laws of the Fermi statistics. It follows from the calculations that the absorption of radiation due to Compton scattering is small as compared with the photoelectric absorption for temperatures $T < 10^{10°}$ K. The two absorptions become comparable if the temperature of the enveloping matter and of the core are $\sim 10^{10°}$ K. and higher. The optical depths τ for the Compton absorption will be $\tau = 10^5$ for giants with radii $\sim 10^{12}$ cm., $\tau = 10^9$ for the sun, $\tau = 10^2$ for white dwarfs provided that the non-degenerate layers of the enveloping gas have each a linear depth of about one-tenth of the radius. It follows that penetrating radiation, formed in the centre of a star, passes through the surrounding matter in a negligibly small time out into space. L. K.

3595. Change of Luminosity Function with Height above Galactic Plane. J. L. Greenstein. *Astrophys. J.* 87. *pp.* 577–581, *June*, 1938.—The stellar density gradient perpendicular to the galactic plane is determined as a function of absolute magnitude from an analysis of star counts in high latitudes. It is found that giants show much greater concentration toward the galactic plane than dwarfs. AUTHOR.

3596. Theoretical Analysis of Wolff's Method of Star Counts in Dark Regions. K. Ogorodnikoff. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 1–2. *pp.* 41–44, 1938. *In English.*—The author examines Wolff's method of determining distance and magnitude of absorption for cases where (1) the stellar counts are made in dark spots and are of equal luminosity; (2) where counts are of the same absolute brightness in dark "clouds" (in obscured regions of large angular extension); (3) where the dispersion of absolute magnitudes is not equal to zero, and here corrections have been derived and formulæ given for both thin and thick nebulæ; (4) where dispersion is large and Wolff's method cannot be applied at all. He discusses the three principal anomalies revealed by the curves on the basis of star counts. The generalised theory gives values of absorption and distances different from Wolff's. For area 7 in Cygnus the latter shows a double nebula at distances 170 and 250 parsecs, absorbing 1·7 stellar magnitudes and the former shows a single nebula at 1000 parsecs, absorbing 2·3 magnitudes. A. S. D. M.

3597. Observations of Novæ, 1937–1938. W. H. Steavenson. *Roy. Astron. Soc., M.N.* 98. *pp.* 673–676, *June,* 1938.

See also Abstracts **3577, 3578, 3621, 3834.**

SUN.

3598. Height of the Chromosphere in 1937. G. Abetti. *Accad. Lincei, Atti,* 27. *pp.* 317–318, *April* 3, 1938.—The observations of the height of the solar chromosphere in 1937 are tabulated. There have been no changes since 1936 and the distribution over the solar sphere has remained the same. In the higher layers of the chromosphere the state of perturbations is the same in 1937 as in 1936, while in the lower layers the activity of the sun has considerably increased in 1937. [See Abstract 3957 (1937).] L. K.

3599. Brightness Variations and Structure of Solar Granulation in the Ultra-Violet. P. ten Bruggencate, W. Grotrian and E. v. d. Pahlen. *Zeits. f. Astrophysik,* 16. 1–2. *pp.* 51–112, 1938.—Simultaneous photographs of granulation in u.v. ($\lambda_{\text{effective}} = 3720$ Å) and infra-red ($\lambda_{\text{effective}} = 7000$ Å) are similar in broad details; the infra-red photographs show a finer resolution of detail. The accuracy of the photometric method used is proved by determination of the edge darkening up to $\cos\theta = 0{\cdot}172$. For $\lambda_{\text{effective}} = 3720$Å there is complete agreement with Abbot's spectro-bolometric measurements which extend to $\cos\theta = 0{\cdot}243$. The deduced mean brightness variation of the granulation amounts to $\Delta m = \pm 0^m{\cdot}033$ in the centre of the disc for 3720 Å. Analysis of the course of the brightness variation in the centre of the disc shows the elements of the granulation have a mean magnitude of 5″; as a result of statistical distribution fluctuations these structure elements produce larger groups of mean magnitude 14″. The corrected mean brightness variation of 5″ granulation at the centre of the sun is $\pm 0^m{\cdot}07$; the mean temperature difference deduced therefrom between the bright and dark and bright regions is about 110°. In small surface regions the brightness variations about the local mean brightness often show a small deviation from a normal distribution; the form of the frequency distribution of the variations leads to resolution into two Gaussian distributions about mean values which differ by $0^m{\cdot}070$. The mean observed brightness variation decreases from centre to edge of the disc according to the equation $\Delta m\,(\theta) = 0^{m}\cdot0327 - 0^{m}\cdot0032\,(\sec\theta - 1)$. When the effects of finite resolution and air movement are taken into consideration it is found that the mean brightness variation of the granulation remains constant over the whole disc within the limits of experimental error. J. E. K.

3600. Two Solar Eruptions. J. C. Dobbie, W. Moss and A. D. Thackeray. *Roy. Astron. Soc., M.N.* 98. *pp.* 606–612, *June,* 1938.—The Solar Physics Observatory, Cambridge, and the Cavendish Laboratory Field Station collaborate for (*a*) photometric measurements of solar Hα radiation during eruptions compared simultaneously with ionosphere radio-echoes reflection coefficients. (*b*) for detection of u.v. continuous light increase. The technique and observing instruments are described. The eruptions were on 1938 March 31 and April 13. The first indicates that the time of a fade-out depends largely on the frequency used; the maximum disturbance velocity must be nearly that of light. The two effects indicate an increase of u.v. radiation rather than a stream of high-speed particles. Both eruptions show that higher peak intensity has greater effect on the ionosphere than extended area; the short-lived phenomenon with a well-defined maximum was accompanied by a similarly sharp ionospheric disturbance, and the long-lived eruption of wide area had no pronounced maximum but had ionospheric conditions that were generally disturbed. A. S. D. M.

3601. Changes of Strong Fraunhofer Lines from Centre to Edge of Sun's Disc. J. Houtgast. *Zeits. f. Astrophysik,* 16. 1–2. *pp.* 43–50, 1938.—In continuation of a series of observations and measurements previously reported [see Abstract 3550 (1936)] the intensity profiles of 20 strong Fraunhofer lines of Ca, Ca^{+}, Na, Mg and Fe are measured at 7 different parts of the sun's disc from the centre to within 0·005R of the edge of the disc. The results are communicated in an abbreviated form; a full description and discussion will be published later. In the case of the lines Mg5184, Ca 4227 and Ca^{+}3934 the results are compared with those of other observers. J. E. K.

3602. New Anomalous Effect in the Short-Wave End of the Solar Spectrum. S. Rodionov, E. Pavlova, and N. Stoopnikov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 1–2. *pp.* 55–57 *and pp.* 59–60, 1938. *In English.*—Measurements were made at Mt. Elbruz in 1935 at 4250m. of the solar intensity simultaneously for four wave-lengths for successive zenithal distances (z). The results are shown graphically. With z between 25° and 60° the results agree with the general equation for the distribution of energy at the short-wave end of the solar spectrum and give the thickness of the O_3 layer 0·25 cm. Between 60° and 70° anomalous distribution is found probably due to anomalous refraction of short waves ($<$3200Å) in the O_3 layer which may be expected near the long-wave boundary of the Hartley band. Measurements were also made by S. Rodionov and E. Pavlova at a height of 2200m. during the Elbruz expedition, and the effect was observed for wave-lengths down to 2980Å. At this lowest wave-length two minima were observed indicating that absorption occurs also at another layer (probably Kennelly-Heaviside layer). For lower wave-lengths the minimum occurs at smaller zenithal distances of the sun. This effect and the anomalous morning course of sunlight appear to be governed by the same general mechanism. R. S. R.

See also Abstract 3590.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE.

3603. Dynamical Oceanography. G. F. McEwen. *Am. Phil. Soc., Proc.* 79. 2. *pp.* 145–166, 1938.—This paper begins with a general historical review of researches on oceanic circulation conducted since the introduction, in the early part of the nineteenth century, of Maury's international cooperative plan of making and reporting ocean observations. The treatment throughout is non-mathematical and an attempt is made to furnish the reader who is not a specialist in the field with a comprehensive survey of progress already made and of problems to be solved. Both theoretical methods of calculating ocean currents from observations of wind, temperature and salinity, and observational methods of determining ocean currents are considered. Special attention is given to errors made in earlier attempts to apply to the ocean theories based upon laboratory experiments. Revisions of these earlier methods and the rapid developments leading to the more satisfactory modern ones are briefly outlined. Then, following an introductory classification of the various forces that generate and maintain oceanic circulation there are general outlines of various methods of applying the principles of physical hydrodynamics to problems of oceanic circulation. There is also an elaboration of the theory of eddy-viscosity and turbulence which processes account for rapid diffusion of momentum, heat and chemical properties. Next a method is explained of calculating the circulation that would account for the departure of actual surface temperatures from their normal values. The explanations mentioned above are restricted to the fundamental part of the mathematical-physical treatment of oceanographic problems involving only the simplest conditions and essential methods. The paper concludes with a supplementary discussion of revisions made necessary by a more detailed consideration of actual conditions such as nearness to coastal boundaries and irregularities in depth. AUTHOR.

LAND, PHYSICS OF THE.

3604. Theory of Plastic Buckling with its Application to Geophysics. P. P. Bijlaard. *K. Akad. Amsterdam, Proc.* 41. 5. *pp.* 468–480, 1938. *In English.*—A mathematical investigation of buckling under plastic conditions throws light upon the occurrence of folding in rocks of the earth's crust. W. A. R.

3605. Measurement of Sand Storms. R. A. Bagnold. *Roy. Soc., Proc.* 167A. *pp.* 282–291, *Aug.* 5, 1938.—Reference is made to results obtained earlier relating the wind and ground surface conditions with the mean flow of sand over open country [see Abstracts 584 (1937) and 116 (1938)]. Observations were made in the Egyptian desert during two sand storms. The apparatus used and its method of operation are described. The results confirm those obtained in the wind tunnel making allowance for the difference in grain size of the sand. Curves are given showing (1) the rate of sand movement over the surface of an eolian sand accumulation carried by a wind of any velocity as measured at a standard height of 1m. above the surface, and (2) the grading of a sand in process of transport. R. S. R.

METEOROLOGY.

3606. Vertical Distribution of Ozone in the Atmosphere. V. H. Regener. *Zeits. f. Physik,* 109. 9–10. *pp.* 642–670, 1938.—A new balloon method is described for estimating the vertical distribution of O_3 in the atmosphere, which is based on the recording of the u.v. solar spectra at different altitudes, and which in contrast to the earlier data is uninfluenced by scattered light and atmospheric effects. The spectra were evaluated by specially designed photometric methods. Two balloon ascents led to the discovery of a minimum for the O_3 pressure in the troposphere, and considerable periodical and spatial fluctuations in the content of O_3 in the lower atmosphere were established. The above phenomena receive very thorough discussion, and an interpretation is given for the vertical distribution in relation to the chemical decomposition of ozone in the troposphere and at the earth's surface. H. H. Ho.

3607. Variations of Solar Constant and their Relation to Weather. M. M. Paranjpe. *Roy. Meteorolog. Soc., J.* 64. *pp.* 459–474; *Disc.,* 474–476, *July,* 1938.—The determinations of the solar constant obtained by the Astrophysical Observatory of the Smithsonian Institute during the last thirty years are discussed, with results which point to the conclusion that the observed variations are mainly due to the defects in the methods of determining the solar constant. If this conclusion is accepted the subsequent work based on the supposed variability of the solar constant is not valid. AUTHOR.

3608. Intensity of U.V. Radiation from the Sky in Iraq. W. P. Kennedy. *Roy. Meteorolog. Soc., J.* 64. *pp.* 489–494; *Disc.,* 494, *July,* 1938.—Hæmotological investigations in Baghdad suggested that the climate altered the blood of normal persons as compared with Britain, and as part of the analysis of the climatic factors, day-to-day measurements were made of the u.v. component of northern sky shine, using Owens's instrument. In this a Chance No. 14 filter is separated from a sheet of photographic paper by a graded series of tubes, giving a scale of 13 arbitrary values from 1 to 204. The upper end of the scale is much more open than the lower, and this must be considered a disadvantage in very bright conditions such as the Iraq summer. The instrument is exposed for 24 hours at 45° to the zenith pointing north. The daily measurements from Aug., 1936, to Aug., 1937, are given in graphic form, and also as monthly means. With the latter, various other meteorological data are tabulated to show the trend and range of climatic variation, and to indicate some of the major causes of fluctuation in the u.v. values. The direction of influence of these variables is discussed briefly, but integration of the factors is not attempted. The paper is preliminary; further studies are in progress. AUTHOR.

3609. Atlantic Flight and its Bearings on Meteorology. F. Entwistle. *Roy. Meteorolog. Soc., J.* 64. *pp.* 355–389, *July,* 1938.—The development of long-distance air routes in recent years has necessitated the expansion of meteorological services in different countries and, in certain cases, the establishment of organised meteorological services where none existed previously. A position is thus being approached gradually in which an organised system of meteorological observations will exist over the greater part of the globe, and material for a study of world meteorology, to an extent hitherto unknown, will be available to investigators. In the case of the long trans-ocean air routes which are projected a special study of prevalent meteorological conditions from the point of view of aviation is necessary. The fundamental data in such cases are supplied by observations from selected ships which bridge the gaps between the fixed continental observing stations and so contribute to the world network. Certain of the meteorological problems which have arisen, owing to the proposed establishment of a regular trans-Atlantic air service, are discussed both from the point of view of aviation requirements and also as contributing to meteorological knowledge. A brief account is also given of the organisation devised to ensure an adequate meteorological service for trans-ocean flights. AUTHOR.

3610. Application of Wet-Bulb Potential Temperature to Air Mass Analysis. Part IV. E. W. Hewson. *Roy. Meteorolog. Soc., J.* 64. *pp.* 407–418 ; *Disc.,* 419–420, *July,* 1938.—This paper describes :— (*a*) The moisture content of subsiding polar continental air over North America, under conditions when there was no likelihood of an increase in the moisture content due to precipitation from overrunning air. Two situations of this type are discussed, and no evidence is found of any appreciable increase above 850 mb. (*b*) The degree of homogeneity in polar continental air masses. The vertical distributions of wet-bulb potential temperature θ' as observed nearly simultaneously at adjacent stations within an air mass are discussed in relation to their effect on the accuracy of computations of subsidence. (*c*) The vertical velocity of air in the warm sector of a depression. It is shown that in the warm sector considered, the ascent of the air near the surface was nearly twice as rapid as that at about 600 mb. The vertical velocity of the surface air was of the order of 4 cm./sec., and that of the air at about 600 mb. was of the order of 2 cm./sec. (*d*) The effect of turbulence in the air near the surface. The changes of temperature and moisture content in the surface layers of a moving air mass are discussed in the light of the theory of turbulence, as developed by Richardson and Taylor. [For Part III see Abstract 3486 (1937).] AUTHOR.

3611. Variation of Pressure Accompanying a Distortion of Air Flow. A. F. Crossley. *Roy. Meteorolog. Soc., J.* 64. *pp.* 477–480 ; *Disc.,* 480–481, *July,* 1938.—It is known that certain meteorological stations frequently record a mean sea level pressure which is lower than that which would be expected from the general run of the isobars by amounts up to about 1 mb. These stations are located in over-exposed situations, such as the tip of a promontory, where the wind speed may be appreciably in excess of the speed in an ideal exposure. In steady motion, the flow of wind over or round the promontory conforms with Bernoulli's equation, which gives a relation between pressure and velocity at points on the same stream line. It is shown that a reasonable increase of wind speed above normal produces a decrease of pressure of the right magnitude. The equation is applied in the first instance to steady frictionless motion, but it is shown that the results apply with little variation to the flow of surface air, as modified by friction. AUTHOR.

3612. Development in Field of Barometric Pressure. R. C. Sutcliffe. *Roy. Meteorolog. Soc., J.* 64. *pp.* 495–504 ; *Disc.,* 505–509, *July,* 1938.—As geostrophic winds are non-divergent it is shown that pressure changes can be determined only by the field of geostrophic departure. Consideration is first given to certain popular conceptions of pressure changes. These are seen to be invalid without considering the dynamical processes involved. Thereafter it is pointed out that, as geostrophic departure is proportional to horizontal acceleration, the theory of depressions can be approached through studying the departure of the velocity from the gradient value. This is done by expanding the acceleration into its partial derivatives and examining each separately. Such an investigation shows that the isallobaric effects alone are unable to explain pressure developments, and it is suggested that all terms may be significant. The effect of the vertical space derivative is specially stressed. A. E. M. G.

3613. Wind Structure Beneath Warm Fronts. C. S. Durst. *Roy. Meteorolog. Soc., J.* 64. *pp.* 516–522; *Disc.*, 522, *July*, 1938.—Fourteen cases of warm fronts passing over the British Isles were selected and the winds observed by means of pilot balloons were compared with the geostrophic winds at various heights up to 10,000 ft. and at distances ranging up to 500 miles. The results were combined in order to get an average value of the departure from the geostrophic wind at certain points. An evaluation is made of the second order terms in the equations at these points, and it is concluded that in this region of a depression the departures from the geostrophic wind are primarily dependent on (*a*) the isallobaric term and (*b*) a term involving the velocity of the cold air away from the incoming warm air and the variation in that direction of the velocity of the air at right angles to that direction. AUTHOR.

3614. Lunar Atmospheric Tide at Accra. S. Chapman. *Roy. Meteorolog. Soc., J.* 64. *pp.* 523–524, *July*, 1938.—The lunar atmospheric tide has hitherto been determined at two stations on the African continent, Helwan and Kimberley. A new determination has now been made from about three years' bi-hourly data for the tropical African station, Accra (5° 33′ N., 0° 12′ W.). The annual mean amplitude of the lunar tidal variation of pressure is found to have the rather small value 45 microbars; the phase angle, 72°, implies that the high (lunar) tide in the atmosphere over Accra occurs about half an hour after the moon's transit; this phase lag is quite normal. AUTHOR.

***3615. Atmospheric Exploration by Radio-Sounding Balloons. H. A. Thomas.** *Roy. Soc., Proc.* 167*A*. *pp.* 227–250, *Aug.* 5, 1938.—Existing methods of exploring the atmosphere by radio-sounding balloons are reviewed briefly, and it is explained that arrangements involving variation of radio frequency are not likely to be satisfactory due to the wide frequency band required and the possibility of appreciable interference. Furthermore, methods involving signalling codes are complex and expensive, and the delineation of the signals at the receiver presents considerable difficulty. The essential features of an original method of exploration are described; in this method a signal of fixed radio frequency is employed and each meteorological instrument produces a continuous variation of modulation frequency. Calibration of the meteorological parameters in terms of frequency can be made independently of the radio transmitter, and measurement of these audio frequencies at the receiver is comparatively easy. The pressure- and temperature-measuring instruments are both arranged to produce variation of modulation frequency without the use of mechanical linkages. The cost of the apparatus is comparatively low, and reproduction in large quantities is possible. The results obtained from a number of experimental ascents are analysed and it is shown that a high degree of reliability and accuracy is obtainable. Using the present balloon, observation of both pressure and temperature up to an altitude of about 10 km. is obtained, the accuracy of the pressure and temperature determinations being about 5 mb. and 1° C. respectively. AUTHOR.

***3616. Nomogram Method of Humidity Control. R. G. Bateson.** *Engineering*, 146. *p*. 57, *July* 8, 1938.—The apparatus described has arms attached to Bourdon tubes connected to wet- and dry-bulb thermometers. Each arm carries a roller at the end and a light straight edge member rests on these rollers. The mid-point of the straight edge member is attached to an arm pivoted to move over the nomogram humidity scale. For control purposes the humidity pointer moves between two air valves or electric contacts so that if the humidity falls below a predetermined value steam or water vapour is admitted to the air and when above a fixed value heating or drying apparatus is employed. R. S. R.

3617. Evaporation Over Catchment Areas. D. Lloyd. *Roy. Meteorolog. Soc., J.* 64. *pp*. 423–437; *Disc*., 437–444, *July*, 1938.—Some of the most authentic data of the general rainfall over British drainage areas and the run-off in annual periods are marshalled. The difference between these observed quantities of water—*i.e.*, the losses in annual periods from all causes—is fundamentally accepted from other research to be principally the effect of evaporation including evapo-transpiration. The paper examines the variation in the annual total loss over eight drainage areas by a statistical method. It is postulated that loss is a joint function of meteorological elements and the geological formation penetrated by any rain water; further, that in the present stage the joint functional causation can be simplified to one of separate functions. Thus, it is assumed that the variations in loss can be associated with the rainfall providing the opportunity for evaporation, with the temperature, with the sunshine, and (as following the primary loss in the zone of aeration, influent seepage may provide a flow in the zone of saturation which later may provide a deferred opportunity for evaporation from the capillary fringe and effluent seepage from ground water) with the geological formation. Regressions of loss on the available postulated controls have been inferred. By inductive reasoning, an equation is found approximately representing the observations over the eight areas, by which the annual loss expected on account of various influences can be estimated. AUTHOR.

3618. Partition of a Region into Rainfall Districts. T. E. W. Schumann and W. L. Hofmeyr. *Roy. Meteorolog. Soc., J.* 64. *pp*. 482–487; *Disc*., 488, *July*, 1938.—A method is here presented for dividing any region into a number of rainfall districts on the basis of seasonal distribution of precipitation. This is accomplished by drawing on a map of the region two systems of lines of equal "phase" and equal "relative amplitude," which are measures respectively of the epoch of maximum rainfall and of the normal fluctuation which occurs in the course of a year. A map of the Union of South Africa is reproduced showing rainfall districts obtained by this method. AUTHORS.

3619. Water Vapour in Stratosphere and Upper Troposphere. D. Brunt and A. K. Kapur. *Roy. Meteorolog. Soc.*, J. 64. *pp*. 510–514; *Disc*., 514–515, *July*, 1938.—Having shown that the humidity mixing ratio should remain constant within the stratosphere, the authors derive a simple formula in terms of the vapour pressure e and the pressure p at the tropopause whereby the total water vapour content of the stratosphere may be calculated. Computations carried out for the northern hemisphere in order to determine the level above which there is 0·3 mm. precipitable water, indicate that whether complete or only 50% saturation be assumed in the upper troposphere, the level coincides with an isothermal surface. Results are tabulated and also represented diagrammatically. Some reference is made to the effect the small quantities of water vapour in the stratosphere as revealed by the present investigation, are likely to have on equilibrium conditions in the O_3 layer. A. E. M. G.

3620. Relation of Brightness of Night Sky to Zenith Distance. J. Rudnick. *Astrophys. J.* 87. *pp.* 584–588, *June*, 1938.—Two all-night series of observations of the brightness of the night sky were obtained, neither of which shows a diurnal variation, in either the red or the blue region of the spectrum. Curves of intensity plotted against zenith distance show no systematic change of colour with zenith distance, although extinction tends to make the sky appear redder toward the horizon. Mean curves are given for determining the intensity of the light of the night sky at any altitude from that at any other altitude. AUTHOR.

3621. Absorption of Light by the Atmosphere. A. Vassy and E. Vassy. *Comptes Rendus*, 206. *pp.* 1893–1895, *June* 20, *and* 207. *pp.* 63–65, *July* 4, 1938.—The spectral absorption of large thicknesses of the lower atmosphere in the near infra-red and visible was measured by a photographic method involving taking spectrograms of a powerful tungsten filament source at distances of 24 and 5 km., and comparing the spectra with calibration spectra obtained from a standard tungsten filament lamp. The advantages of the method are enumerated. For the u.v. a modified method employing a H_2 tube as source [see Abstract 3618 (1934)] is used. To measure the absorption of the total atmosphere spectrograms of Vega and Sirius are taken at different zenith angles, and compared with calibration spectra as in the lower atmosphere measurements. Measurements have been performed for several months at an altitude of 1635m. at Ifrane (Morocco). Spectral absorption curves were taken on nine clear nights in July, August and September. The curves fall into two groups; in the first, the difference between the curves is constant for all wave-lengths; in the second the differences are irregular. In the first group, much of the absorption is shown to be due to the characteristic absorption bands of H_2O-vapour, O_2 and O_3. Added to this is an absorption probably best explained as due to molecular diffusion according to the Rayleigh-Cabannes formula; and there is also an absorption, differing from night to night, but constant for all wave-lengths and probably due to particles in the air sufficiently large to absorb non-selectively. In the second group the absorption was greater, and H_2O bands were more prominent. D. H. F.

3622. Scattering of Light by Particles in the Air. H. Grisollet. *Comptes Rendus*, 206. *pp.* 1912–1914, *June* 20, 1938.—An investigation of the scattering of light by particles suspended in the air in the neighbourhood of the earth has been carried out at Montsouris Observatory during the period Jan., 1934, to March, 1936. The relationships found to exist between the intensity and state of polarisation of tho scattered light, the angle of scattering, and the concentration of particles, are described. [See Abstract 3564 (1936).] W. H. Wal.

3623. Formation of Free Atoms of Sodium in the Upper Atmosphere. P. Bernard. *Comptes Rendus*, 206. *pp.* 1669–1672, *May* 30, 1938.—The mechanisms whereby free Na atoms are formed in the upper atmosphere (60 km.) at a relatively high temperature (150°) are discussed. NaCl is present probably as a result of vaporisation of sea water and it reacts with atomic H to give free Na atoms. The atomic

H may be formed by decomposition of water or more probably by the reaction $N_2\ (A^3\Sigma)+H_2O\rightarrow N_2\ (X^1\Sigma)+OH+H$. Spectroscopic evidence supports the latter reaction. [See following Abstract.] W. R. A.

3624. Bands of the OH Molecule in the Spectrum of the Night Sky. G. Déjardin and R. Bernard. *Comptes Rendus,* 206. *pp.* 1747–1748, *June* 8, 1938.—The hypothesis that in a certain region of the upper atmosphere atomic H is formed and can react [see preceding Abstract] is applied in considering certain portions of the spectrum of the night sky. Some 30 lines in the spectral ranges 3060—3245Å. and 3420—3520 Å. can be attributed as due to the OH molecule by comparison with spectra of OH produced in the laboratory. The differences in the relative intensities of the lines in the two spectra (night sky and laboratory OH) may arise from different modes of excitation of OH. W. R. A.

3625. Height of Layer whence D Rays are Emitted and Origin of Na Atoms in this Layer. G. Déjardin and R. Bernard. *Comptes Rendus,* 207. *pp.* 81–83, *July* 4, 1938.—Reasons are given for thinking that the height of the layer, 130 km. obtained from Cabannes and Dufay's formula may have a minimum of 60 km. It is considered that the Na atoms are more probably of terrestrial origin and originate by upward diffusion of NaCl from the oceans and the decomposition at high temperatures and low pressures of these molecules. Volcanic eruptions may have helped by the presence of Na_2O in the form of dust which persists for a long time at high levels. The presence of this dust is indicated by changes of solar radiation and atmospheric absorption between 1883 and 1914 with four periods having a perturbation of 2 to 5 years. **Errata,** *ibid. p.* 384, *Aug.* 8, 1938. [See Abstract 1552 (1938).] R. S. R.

3626. Atmospheric Optical Phenomena in North-East Land. R. Moss. *Roy. Meteorolog. Soc., J.* 64. *pp.* 451–458; *Disc.,* 458, *July,* 1938.—A record is given of the various atmospheric optical phenomena observed during the ten months' occupation of a station on the inland ice of North-East Land (80° N., 20° E.) by the Oxford University Arctic Expedition, 1935–36. As well as the more common mock-suns and mock-moons, several complexes were observed, notably on June 6, 1936, when the comparatively rare Parry arc occurred. There were also many instances of a phenomenon which has occasionally been described previously, but which has not been distinguished from others, with which it usually occurs simultaneously. It takes the form of a pair of *white* mock-suns on or near the visible horizon; they do not appear to be essentially connected with the usual "prismatic" halo phenomena. The name "hypohelia" is proposed for them. AUTHOR.

See also Abstracts 3602, 3605, 3629, 3672.

SEISMOLOGY.

3627. Anomalous Dispersion of Elastic Surface Waves. K. Sezawa. *Tokyo Univ. Earthquake Research Inst., Bull.* 16 *pp.* 225–232, *June,* 1938. *In English.*—From a mathematical investigation it was found that while the dispersion of Love waves is normal, the dispersion of Rayleigh waves in certain special conditions of stratification is anomalous. This condition can exist for a certain range of wave-lengths transmitted through the surface layer if the velocity of bodily waves in the upper layer is greater than that in an adjacent layer of greater density. For this kind of dispersion the propagational velocity of surface waves exceeds

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19

that for transverse waves in the upper or lower media. Except for a few conditions the distribution of displacements with depth does not differ greatly from that of the usual Rayleigh waves. R. S. R.

See also Abstract 3505.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

3628. Variation of Electrical Conductivity of the Atmosphere with Height. D. C. Rose. *Canad. J. of Research*, 16, *Sect. A. pp.* 107–130, *June*, 1938.—The conductivity of the atmosphere has been measured during flights in aeroplanes near ground level and up to about 16,000 ft. Seven flights were made during the autumn and winter of 1936–1937. The Gerdien type of conductivity apparatus was used. An attempt was also made to measure potential gradients by the radioactive collector method. This method was impracticable, probably because of charges acquired by the aeroplane. It did, however, serve to indicate the presence of intense local space charges such as charged clouds. On one flight, observations were taken near a thunderstorm, but owing to difficulties in interpretation no conclusions regarding the exact nature or location of the charges could be drawn. The conductivity increased rapidly with height in a manner in general agreement with the data of other observers. Positive and negative conductivities were found to be equal, within the experimental error, at heights between about 1000 and 10,000 ft. At higher altitudes the negative conductivity was greater than the positive. The presence of clouds and frontal discontinuities usually caused a reduction in continuities. AUTHOR.

3629. Mechanism of Thundery Conditions at Karachi. S. Mal and B. N. Desai. *Roy. Meteorolog. Soc., J.* 64. *pp.* 525–537, *July*, 1938.—Weather conditions and aeroplane ascents at Karachi between June 22 and July 2, 1936, have been examined for understanding the mechanism of thundery conditions which prevailed there during that period. It is observed that thundery conditions occurred when the characteristic monsoon inversion was absent and there was a sufficiently deep layer of air which when raised to a certain level either by insolation, arrival of sea air, or convergence of winds, released an appreciable amount of energy of latent instability. AUTHORS.

3630. Magnetic Anomalies Around Volcanic Craters. T. Nagata. *Tokyo Univ. Earthquake Research Inst., Bull.* 16. *pp.* 288–299, *June*, 1938. *In English.*—The method employed in obtaining observations of magnetic declination around the crater of the volcano Mihara is explained and the results are tabulated. The anomalies obtained are supposed to be due to singularities in the topography of the crater and probably due to induced magnetism in the rocks with large magnetic susceptibility around the crater. The susceptibility is calculated from the observed data. It is shown that the earth's magnetic field in the island has an anomalous distribution almost equal to the magnetic field due to a bar magnet placed in the centre of the volcano coaxially with the normal magnetic meridian. R. S. R.

RADIOACTIVITY.

3631. Excitation Mechanism in Atomic Nuclei. L. Goldstein. *Comptes Rendus*, 206. *pp.* 1880–1882, *June* 20, 1938.—The mean life τ of an excited state is calculated from the viscosity of the intra-nuclear gas. For a nucleus containing A heavy particles, $\tau = 1\cdot 43 \times 10^{-23}$ A sec., which, in the case of light nuclei, is of the same order as the time of passage of a heavy particle across the diameter. It is thought that the intra-nuclear gas model furnishes lower limits for the values of τ. G. C. E.

3632. Excitation of Nitrogen Nuclei by Rapid Neutrons through Paraffin. J. Thibaud and P. Comparat. *Comptes Rendus*, 206. *pp.* 1963–1965, *June* 27, 1938.—Neutrons from Be + Rn were passed through a variable thickness of matter (paraffin, Pb, Na, Fe, Bi, etc.) and then allowed to fall on $^{14}_{7}$N. A variable number of the $^{14}_{7}$N nuclei were disintegrated ($^{14}_{7}$N, $n \rightarrow {}^{11}_{5}$B, α). The effect is specially marked with paraffin. When the number disintegrated is plotted against thickness (of paraffin) the curve obtained is not smooth, but shows a number of alternate maxima and minima. These diminish absolutely, not relatively, as the thickness increases. Slow neutrons are not concerned as interposition of a Cd screen does not alter the positions of the maxima and minima. The cause is discussed, and considered to be probably resonance. C. A. S.

3633. Excitation Functions of the (α, n)-Transformations of N, Al and A. E. Fünfer. *Ann. d. Physik*, 32. 4. *pp.* 313–335, *June*, 1938.—With the energetic α-rays of Th C the excitation curves of the (α, n)-transformations of N, Al, and A were investigated. The homogeneity of the bundle of rays is sufficiently good to analyse the resonance positions situated near each other. The observation of the neutrons was carried out in proportional counting tubes which were coated inside with B, whereby the neutrons previously in layers of paraffin were checked in thermal velocity. The excitation curves consist almost exclusively of resonance regions. In the regions lying between the yield of neutrons is very small. The upper limit of the extent of the resonance level is about 50 kV. It must be assumed that the effective extent is considerably smaller. The mean distance between the levels lies between 100 and 300 kV. Especially inportant is the fact that in the case of N sharp resonances appear with energies above the height of the potential threshold. This is in favour of the idea of the intermediate nucleus as formulated by Bohr. On comparison of the experimentally found term distances with the theoretical values no agreement is found. The fact that the term distances for Al are not smaller than for N may be understood on the basis of selective rules which limit the possibility of the excitation level in the intermediate nucleus P^{31} formed from Al. Further a comparison is made between the (α, n)- and the (α, p)-transformation of Al and this shows that in both cases the same resonance positions frequently occur. Thus the greater yield of A relatively to N may be explained; perhaps with N the probability of penetration of the α-particles is greater. With A no (α, p)-process exists, whilst with N the destruction of the excited intermediate nucleus is caused much more frequently by the emission of a proton than of a neutron. J. J. S.

3634. Theory of Excitation Functions on Basis of Many-Body Model. E. J. Konopinski and H. A. Bethe. *Phys. Rev.* 54. *pp.* 130–138, *July* 15, 1938.—The theory of transmutation functions for charged particles is examined in the light of recent developments in nuclear theory. It is found that ignoring all factors besides the penetrability of the incident particle is justifiable only for processes without effective competition. For these, the usual applications of the Gamow-Condon-Gurney theory must be modified to include the influence of incident particles with non-vanishing orbital momentum which causes a continued rise of the yield for energies greater than the Coulomb barrier. For processes subject to effective competition, the comparative density of residual states available to each alternative process is important in determining relative yields. The densities of the states are calculated on the basis of the liquid drop model for the nucleus and a table is obtained giving the relative probabilities of neutron and charged particle emissions. The overwhelming factor in favour of neutron emission by heavy nuclei seems to be confirmed by experiment. The shape of an excitation curve expected for the less probable of two processes is shown. Finally the effect of selection rules in the yield curves of reactions involving very light nuclei is considered. Special cases are discussed. AUTHORS.

3635. Periods of Radioactive Silver Isotopes. A. Moussa and H. Laurent. *J. de Physique et le Radium*, 9. *pp.* 245–250, *June*, 1938.—An improved apparatus for measuring the period of radioactive ^{108}Ag obtained by bombarding Ag with slow neutrons is described, and the necessary corrections to the observations are given. Calculations of the most accurate values of the periods from the measurements obtained are reported in detail. The values found are: ^{108}Ag, 150 ± 2 sec; ^{110}Ag, 23·9 ± 1 sec. N. M. B.

3636. Long-Period Radioactivity in Ag, Cs and In Activated by Slow Neutrons. K. Alexeeva. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 8. *pp.* 553–555, 1938. *In English.*—Previous work [see Abstract 603 (1938)] is extended to cover the bombardment of a great many elements by slow neutrons for a period of 6 to 7 months. Long-period radioactivity was found to be produced in Ag, Cs and In, the half-lives being estimated at about 2 y., 1 y. and 60 d. respectively. F. C. C.

3637. Absorption and Coincidence Experiments on the Radiations from the Radioactive Sodium, Na^{24}. N. Feather and J. V. Dunworth. *Cambridge Phil. Soc., Proc.* 34. *pp.* 442–449, *July*, 1938.—The radiations from Na^{24} have been examined by the absorption and coincidence methods and evidence has been obtained for the conclusion that the energy spectrum of the β-particles is a simple continuous spectrum with an upper limit at $1{\cdot}40 \times 10^6$ eV, and that the emission of γ-radiation after the particle disintegration takes place almost always as a cascade process in which at least two quanta are involved, and very rarely by a single transition to the ground state. AUTHORS.

3638. Disintegration of Boron. I. Zlotowski. *Comptes Rendus*, 207. *pp.* 148–150, *July* 11, 1938.—In a note on the disintegration of B on bombardment with α-particles the relative yield of protons and deuterons is discussed; the ratio is found to be approximately as 100 to 3. The significance of this is considered. G. O. B.

3639. New Transformation Product of Long Life in the Trans-Uranium Series. O. Hahn, J. Meitner and F. Strassmann. *Naturwiss.* 26. *pp.* 475–476, *July* 22, 1938.—Irradiation of U within paraffin with neutrons for some months gave rise to a new transformation product with a half-life of 60 days. The genetic relationships of this product have not yet been definitely proved, but it is probably an eka-iridium (atomic number 95) which is formed from eka-osmium (atomic number 94) of half-life 5·7 hr. A. J. M.

3640. Artificial Disintegration of Th with Neutrons. L. Meitner, F. Strassmann and O. Hahn. *Zeits. f. Physik*, 109. 7–8. *pp.* 538–552, 1938.—It is shown that four disintegration series result from the bombardment of Th with fast or slow neutrons. One series results from an absorption process, the remaining three series, which are isomeric, being due to the abstraction of an α-particle. The four β-activities have half-value periods of 26 min., <1 min., 15 min. and ~ 4 hr. respectively. The processes may also be produced by bombardment of Th with the 2·5 eMV neutrons from the D–D reaction. F. C. C.

3641. Yield of α-Particles from Be Bombarded by Protons. G. T. Hatch. *Phys. Rev.* 54. *pp.* 165–171, *Aug.* 1, 1938.—Experiments to determine the excitation function of the reaction $_4\mathrm{Be}^9(p, \alpha)_3\mathrm{Li}^6$ for proton energies up to 400 kV are reported. It is shown that the yield is very large, *ca.* 4×10^{-6} α-particle per proton at 400 kV, but the derived thin target curve shows a marked flattening from the exponential form observed at lower voltages. The cross-section is nearly constant above 300 kV, and has a value of about $2 \cdot 3 \times 10^{-25}$ cm^2. AUTHOR.

3642. Energy Change in Be-Li Transmutation by Proton Bombardment. S. K. Allison, L. S. Skaggs and N. M. Smith, Jr. *Phys. Rev.* 54. *pp.* 171–175, *Aug.* 1, 1938.—The very high yield of α-particles from the reaction $_4\mathrm{Be}^9(p, \alpha)_3\mathrm{Li}^6$ has made it possible to measure their energies by deviating a beam through 90° in an electrostatic field. A steady source of high voltage, which could be measured to 0·1% up to 40,000 V, was used to deflect the α-particles. Two experiments are reported in which the Be was bombarded by 320 kV and 383 kV protons, respectively. The energy distribution curves of the alphas show a sharp high energy limit, and this limit increases with bombarding energy of the protons. The experiment shows that the energy balance of the reaction is $2 \cdot 152 \pm 0 \cdot 04$ eMV, corresponding to $2 \cdot 310 \pm 0 \cdot 04 \times 10^{-3}$ atomic weight unit. This establishes the difference in mass between Be^9 and Li^6 as $2 \cdot 99804 \pm 0 \cdot 00009$. If we assume that of the two, the mass of Li^6 is more accurately known, and adopt Livingston and Bethe's value of $6 \cdot 01686 \pm 0 \cdot 00020$, the experiment shows that the mass of Be^9 is $9 \cdot 01491 \pm 0 \cdot 00025$. AUTHORS.

3643. Anomalous Scattering of α-Particles. H. S. W. Massey and C. B. O. Mohr. *Cambridge Phil. Soc., Proc.* 34. *pp.* 498–501, *July*, 1938.—Recent experiments of Mohr and Pringle [see Abstract 2524 (1937)] on the anomalous scattering of α-particles in H_2, D_2 and He have revealed the existence of appreciable deviations from Coulomb's law at quite large distances. Ordinary electrostatic polarisation of the colliding nuclei has been suggested as a mechanism to account for this. Since the structure of the deuteron is known reasonably well its polarisability can be calculated. The α-particle has a more compact structure than the deuteron, thus its polarisability is probably less than that of the deuteron. The polarisability of the α-particle can be obtained from measurements of the scattering of α-particles in He, and this value can be compared with the deuteron value as a limit. The results of the test are entirely unsatisfactory, showing that classical electrostatic polarisation cannot by itself explain anomalous scattering. G. O. B.

3644. Variation of Ionisation with Range of α-Particles, Protons, Deuterons and ³H Particles. J. C. Bower. *Cambridge Phil. Soc., Proc.* 34. *pp.* 450–458, *July,* 1938.—Photometrical determinations of the variation of density along photographs of expansion chamber tracks have enabled the positions of maximum ionising efficiency for single α-particles, protons, deuterons, and ³H particles to be determined. The maximum rate of ionisation for an α-particle in air occurs when it has a residual range of 3·7 mm. in standard air. The distance of the position of maximum ionising efficiency from the end of the particle range is shown to be approximately in the ratio of the particle mass in the case of the particles, ¹H, ²H and ³H. AUTHOR.

3645. Theory of β-Decay. M. H. Hebb. *Physica,* 5. *pp.* 701–704, *Aug.,* 1938. *In English.*—The new method of Crane and Halpern [see Abstract 2843 (1938)] for detecting the neutrino is discussed. For this method to be valid it is necessary that the β-disintegration be adiabatic. Theoretical arguments that this is so are advanced. AUTHOR.

3646. Production of Positron-Electron Pairs during the Passage of β-Particles through Matter. N. Feather and J. V. Dunworth. *Cambridge Phil. Soc., Proc.* 34. *pp.* 435–441, *July,* 1938.—The method of coincidence counting has been applied to an investigation of the possible production of positron-electron pairs by the high energy β-particles from a source of uranium X in absorbers of aluminium, brass and lead. The results are not inconsistent with the high values recently reported for atomic cross-sections for the effect, nor with the suggestion that the atomic cross-section is proportional to the first power of the atomic number rather than the second. Suggestions are made for the use of the β-particles from artificially radioactive substances in an attempt to increase the sensitivity of the method. AUTHORS.

3647. Probability of Pair Creation in Kr by γ-Rays. L. V. Grošev and I. M. Frank. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 7. *pp.* 419–422, 1938. *In English.*—Using a special hermetically sealed cloud chamber, the creation of pairs of positrons and electrons in Kr by the γ-rays from Rd-Th is examined. The results are divided into two groups covering the energy intervals 0·5–1 eMV and greater than 1 eMV respectively. Methods are devised for allowing for spurious pairs due to electrons which have suffered single nuclear scattering. The effective cross-section for pair production is found to be in approximate agreement with the theory of Jaeger and Hulme. [See following Abstract.]
F. C. C.

3648. Angular Distribution of Pairs in Kr. L. V. Grošev and I. M. Frank. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 1–2. *pp.* 49–54, 1938. *In English.*—Continuing previous work [see preceding Abstract] examination is made of the angular distribution of pairs in Kr produced by γ-rays from ThC″. The data agree with the theory of Bethe and Heitler. There appears to be a real difference in the angular distribution of the positrons and electrons, particularly at angles <15°, for this region includes 34% of the positrons and only 18% of the electrons. The mean energy difference between the positrons and electrons is 100 ekV and is in agreement with theory. This difference increases with increasing atomic number. The average angle between the pairs is 48°, which is considerably higher than that reported by previous workers. [See following Abstract.] F. C. C.

3649. Nuclear Impulse in Pair Creation. L. V. Grošev and I. M. Frank. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 4. *pp.* 239–242, 1938. *In English.*—Calculation is made of the impulse transmitted to the nucleus during the creation of pairs by γ-rays. For the principal γ-ray line from ThC″, namely $h\nu = 5{\cdot}2\ mc^2$, the maximum impulse transmitted to the nucleus is $0{\cdot}4\ mc$. In most cases the departure from coplanarity between the plane of the positron and electron tracks and the direction of the incident photon is not greater than 12°. [See preceding Abstract.] F. C. C.

3650. γ-Radiation from Actinium. E. Kara-Michailova. *Cambridge Phil. Soc., Proc.* 34. *pp.* 429–434, *July,* 1938.—Owing to uncertainty in the values of the intensity of γ-radiation emitted by active Ac deposits, this investigation was made in an attempt to obtain a more direct estimate of the total energy emitted as γ-radiation by Ac(B+C). An ionisation chamber filled with N_2 at 30 atm. was used since the γ-radiation was very weak. The results of the experiment are entirely inconclusive and do not permit of a decision for or against the proposed level scheme for the AcC nucleus. G. O. B.

3651. γ-Ray Ionisation in Gases at High Pressures. J. Clay and M. Kwieser. *Physica,* 5. *pp.* 725–736, *Aug.,* 1938. *In English.*—The ionisation was measured in Kr, A and N_2 at pressures up to 140 atm. and fields up to 6000 V/cm. Two different vessels were used. For each gas there is a range of pressures for which an excess of ionisation above the normal value has been found. The influence of a small amount of O_2 in A and N_2 has been measured. At high ionisation and lower field the amount of volume-recombination could be measured by using a new method. The influence of pressure could be tested. The relation of ionisation by γ-rays for different gases was measured, but it was found not to be the same for rays of different energy. AUTHORS.

3652. Dependence of Ionisation by Penetrating- and γ-Radiation upon Pressure. J. Clay. *Zeits. f. Physik,* 109. 7–8. *pp.* 477–484, 1938.—Experiments were carried out to test the validity of the extrapolation of Jaffé's columnar ionisation formula in the linear form given by Zanstra, for a number of gases up to a pressure of 150 atm. with penetrating radiation and γ-radiation as ionising agents. The two radiations differ in their dependence of the saturation gradient on the field strength and the gas pressure, nor is the critical pressure the same for both. Below the critical pressure the saturation current is proportional to the pressure but above it, it is given by an expression $I = Ap + B + Cp$ where A, B and C depend on the gas and the materials of the walls, the values being different for the two radiations. For photons, C is equal to zero. With γ-radiation, the ionisation is approximately proportional to Z^2 for different gases, whereas for penetrating radiation it is approximately proportional to the density. F. C. C.

***3653. New Valve Counting Circuits. H. J. Reich.** *Rev. Sci. Instruments,* 9. *pp.* 222–223, *July,* 1938.—Various new valve trigger circuits are described. They have been operated successfully at frequencies above 15 kc./sec. but the upper frequency limit has not yet been determined. F. C. C.

***3654. Improvement in Coincidence-Counting Circuit. S. Gorodetzky.** *Comptes Rendus,* 207. *pp.* 57–58, *July* 4, 1938.—It is pointed out that in coincidence-counting circuits of the Rossi-type, the power of discriminating between true and false coincidences, and also

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19

the resolving power, may be reduced if the impulse passed on by the group of valves to which the counters are individually coupled is large. It is shown that if the impulse, instead of being applied directly to the grid of the succeeding valve, is applied to a potentiometer, from which a suitable fraction is tapped off and applied to the grid, then this state of affairs is largely remedied. [See Abstract 2405 (1938).] D. H. F.

***3655. Upper Limit of Ion Energy Obtainable by Means of the Cyclotron. J. Khurgin.** *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 4. *pp.* 237–238, 1938. *In English.*—It is shown theoretically that (1) the decrease of the magnetic field towards the edge of the apparatus and (2) the relativistic increase of mass with velocity, result in an increased period of revolution of the ions in a cyclotron and the consequent destruction of resonance. The maximum energy obtainable for an accelerating voltage of 0·1 eMV is shown to be 21·9 eMV for protons, 31·0 eMV for deuterons and 62 eMV for α-particles for the most favourable case of a uniform magnetic field. Any inhomogeneity in the magnetic field results in a lowering of the maximum energy by an amount which may be 50%. The values obtained are about twice those given recently by Bethe and Rose and the divergence in the results is discussed.
F. C. C.

See also Abstracts 3434, 3559.

RADIATION.

ABSORPTION.

3656. Absorption Coefficients of Ozone in the Region of the Chappuis Bands. A. Vassy. *Comptes Rendus*, 206. *pp.* 1638–1639, *May* 30, 1938.—Data for the absorption coefficients of O_3 at 16 different thicknesses (from 7 to 26 cm.) and at a mean temperature of 18° are recorded. [See Abstract 3041 (1937).] W. R. A.

COLORIMETRY.

***3657. Objective Measurement of Colour. J. W. Perry.** *Journ. Sci. Instruments*, 15. *pp.* 270–277, *Aug.*, 1938.—The general principles of direct photoelectric colour measurement and their application to the "Blancometers" are considered. Two categories of such colour measurement are distinguished. A description is given of the "Blancometers" and the method of measurement employed in their application to the measurement of colour differences. AUTHOR.

EMISSION.

3658. Interaction between a Photon and an Electron, in accordance with Wave Mechanics. J. Géhéniau. *Comptes Rendus*, 206. *pp.* 1711–1713, *June* 8, 1938.—The elementary phenomena concerned in the interaction between a photon and an electron are discussed in terms of wave mechanics, employing a system of trihedral coordinates, without appeal to quantum field theory. J. S. G. T.

3659. Equation of Propagation of a Photon in Non-Euclidean Space. M. A. Tonnelat-Baudot. *Comptes Rendus*, 206. *pp.* 1714–1715, *June* 8, 1938.—The equations of propagation of a photon in a twisted non-Euclidean space of zero curvature are derived by the application of Dirac's general matrix theory. The identity relations and the electromagnetic equations appear in modified form, the former containing a second member and the latter supplementary terms. J. S. G. T.

3660. Classical Theory of Radiating Electrons. P. A. M. Dirac. *Roy. Soc., Proc.* 167*A*, *pp.* 148–169, *Aug.* 5, 1938.—The object of the paper is to set up in the classical theory a self-consistent scheme of equations which may be used to calculate all the results that can be obtained from experiment about the interaction of electrons and radiation. The electron is treated as a point charge and the difficulties of the infinite Coulomb energy are avoided by a procedure of direct omission or subtraction of unwanted terms, somewhat similar to what has been used in the theory of the positron. The equations obtained are of the same form as those already in current use, but in their physical interpretation the finite size of the electron reappears in a new sense, the interior of the electron being a region of space through which signals can be transmitted faster than light. AUTHOR.

3661. Large Cosmic-Ray Bursts and Cascade Theory. C. G. Montgomery and D. D. Montgomery. *Phys. Rev.* 53. *pp.* 955–959, *June* 15, 1938.—On the basis of the cascade theory of showers, the energy spectrum of the electrons and photons incident on a thin layer of material is calculated from the observed frequency distribution in size of bursts. The energy spectrum obtained is in agreement with that calculated by Heitler to explain the variation of cosmic-ray intensity with altitude. An estimate of the number of electrons necessary to produce the observed frequency of bursts is in good agreement with cloud-chamber observations. Calculations of the number and frequency distribution of showers from large thicknesses of material show considerable discrepancies from observed results, but this is probably due to the effect of the penetrating component. It is concluded that the cascade theory is entirely adequate to account for all the observed bursts; the Heisenberg single-process mechanism of shower production need not be invoked. D. H. F.

3662. Solar Diurnal Variation of Cosmic-Ray Intensity as a Function of Latitude. J. L. Thompson. *Phys. Rev.* 54. *pp.* 93–96, *July* 15, 1938.—The cosmic-ray data collected by A. H. Compton and R. N. Turner on the Pacific Ocean from March 17, 1936 to Jan. 18, 1937, have been analysed for a possible change with latitude of the solar diurnal intensity variation. A new geomagnetic latitude curve is shown based on these data and designed to remove periodic fluctuations due to unequal distribution of data with time. A method of combining data from a wide latitude range is developed and applied. Solar diurnal variation curves for latitudes ranging from $54 \cdot 7^\circ$ N. to 40° S. (geomagnetic) show no substantial variation in either amplitude or phase. The mean amplitude of the first harmonic of a Fourier analysis is found to be $0 \cdot 24\%$ with time of maximum being 14 hr. 06 min. AUTHOR.

3663. Sidereal Time Variation of Cosmic Radiation. H. Alfvén. *Phys. Rev.* 54. *pp.* 97–98, *July* 15, 1938.—If it is supposed that the positive and negative cosmic-ray particles are not equal in number, the resulting space charge will be neutralised by slowly moving ions which should follow the motion of the stars. If the cosmic-ray particles are not isotropic relative to the stellar system, as for example if they do not share the motion of galactic rotation, the relative motion of the slow ions and the cosmic-ray particles of opposite sign produces in effect an electric current. Calculation shows that the resulting magnetic field may become as great as 10^{-1} gauss if there is a considerable difference between the number of positive and negative particles. It is shown that the anisotropy corresponding to even a small sidereal time variation of the cosmic radiation would imply such great magnetic fields as to bend the paths of cosmic-ray particles in curves of radii small compared with interstellar distances. Therefore, the high degree of isotropy of the cosmic radiation is a necessary consequence of the fact that it consists mainly of charged particles and does not tell us anything about the place of origin of the radiation. AUTHOR.

3664. Cosmic-Ray Intensity at High Elevations in Northern Latitudes. T. H. Johnson. *Phys. Rev.* 54. *pp.* 151–152, *Aug.* 1, 1938.—Balloon flights with vertical coincidence counters for cosmic-ray measurements have been made at geomagnetic latitudes 56° N. and 69° N. Within the accuracy of the measurements there is no further increase of intensity above 56° N. at atmospheric depths greater than 2 m. of water. AUTHOR.

3665. General Theory of the Earth's Shadow Effect of Cosmic Radiation. E. J. Schremp. *Phys. Rev.* 54. *pp.* 153–157, *Aug.* 1, 1938.—An inquiry is made into the fundamental mode of origin of the allowed cone of cosmic radiation introduced by Lemaître and Vallarta [see Abstract 4682 (1936)]. Two kinds of allowed cone are distinguished. One of these, that discussed by Lemaître and Vallarta, postulates the presence of an impenetrable earth; for it all forbidden directions are due to the earth's shadow effect. The second type of allowed cone, applicable in the first approximation to such problems as that of the sun's magnetic field, does not postulate the presence of an impenetrable earth; for it all forbidden directions are associated with bounded charged particle orbits. The general topological features of each of these kinds of allowed cone, and their relationship to one another, are described. [See following Abstract.] AUTHOR.

3666. Simple Shadow Cone of Cosmic Radiation. E. J. Schremp. *Phys. Rev.* 54. *pp.* 158–162, *Aug.* 1, 1938.—The present paper is a brief summary of the results obtained from a study, by means of Bush's differential analyser, of those trajectories of a charged particle in the field of a magnetic dipole which determine the simple shadow cone for all latitudes and energies. [See preceding Abstract.] AUTHOR.

See also Abstracts 3594, 3645, 3652, 3654, 3731, 3742.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

3667. Fluorescence of Chlorins. A. Stern. *Zeits. f. phys. Chem.* 182. *Abt.A.* 3. *pp.* 186–192, 1938.—The fluorescence spectrum of meso-pyrrochlorin is the same in type as that of pyrroporphyrin. Both spectra have five bands but that of meso-pyrrochlorin is displaced towards the red. The similarity between the fluorescence spectra of the poprhyrins and the corresponding chlorins indicates that the chlorins and chlorophyll derivatives in general have the same inner ring system as the porphyrins. This is supported by the relationship which has also been observed between absorption and fluorescence. A. J. M.

3668. ZnS Phosphors. F. Seitz. *J. Chem. Phys.* 6. *pp.* 454–461, *Aug.*, 1938.—The properties of pure and Cu-activated ZnS phosphors are described, and an attempt is made to interpret these properties following the plan of a previous paper on alkali halide phosphors activated by Tl. It is pointed out, as has been done by previous workers, that the combination of photoconductivity and bimolecular decay law of phosphorescence implies that an ionisation process accompanies the excitation of ZnS phosphors. By applying the ideas of the quantum theory of solids, it is shown that this ionisation process does not correspond to the freeing of an electron from the Zn^{++} or S^{--} ions of the lattice. It is concluded that the pure ZnS phosphor probably contains neutral interstitial Zn atoms, and that these are responsible for the luminescence and photoconductivity. By analogous reasoning, it is concluded that the Cu-activated phosphor contains interstitial Cu atoms. The relative stability of interstitial copper atoms and substitutional copper ions is discussed in terms of the Schottky-Wagner theory of deviations from stoichiometrical proportions. It is concluded that the interstitial Cu atoms probably are in a metastable condition. AUTHOR.

3669. Thermo-Luminescence of Quartz Exposed to X-Rays. T. Futagami. *Phys. Math. Soc. Japan, Proc.* 20. *pp.* 458–466, *June*, 1938.—Quartz, exposed to X-rays, obtains a smoky colour, and if the crystal is heated, the colour will fade away, emitting thereby a blue thermo-luminescence. The absorption spectrum of coloured quartz was examined, and it was found that it extends all over the regions of infra-red, visible and u.v. spectra, and that there exist two flat maxima at 390 mμ and 302 mμ. The intensity variations of the thermo-luminescence with respect to time and temperature were investigated by a rotating film apparatus. The spectrum of the thermo-luminescence was obtained by a quartz spectrograph, and it was found to be a continuous one ranging from 610 mμ to 385 mμ with a maximum at 469 mμ. The intensity distribution of the spectrum was also determined. AUTHOR.

3670. Kathodoluminescence of Luminescent Al_2O_3. E. Iwase. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers No.* 800. *pp.* 761–774, *July*, 1938. *In English.*—On several specimens of natural Al_2O_3 minerals from Japan as well as from foreign countries, the luminescence under excitation by kathode rays was examined. Spectrographical studies were made on the kathodoluminescence exhibited by specimens of Japanese corundum. As the specimens of ruby from North Carolina exceed any other in the brightness of the luminescence, their emissions, excited by both kathode and u.v. rays, and their light-transmission were investigated in some detail. Some of the emission bands observed have not yet been recorded by any former investigators. For the luminiferous synthetic materials, Al_2O_3-Bi, Al_2O_3-U, Al_2O_3-Sm, Al_2O_3-Mn, and Al_2O_3-Cr, the influence of the concentration of activators and the calcination temperature upon the colour of kathodoluminescence was examined. AUTHOR.

3671. Formation and Excitation of Molecular Ions in Active Nitrogen. U. Stille. *Zeits. f. Physik*, 109. 7–8. *pp.* 491–502, 1938.—A criticism of the excitation mechanism proposed by Kaplan for the high pressure excitation of the negative bands in the after-glow. A collision between a molecule in the G-K level and a metastable $A^3\Sigma_u^+$ molecule does not provide sufficient energy whilst a collision between two molecules in G-K levels provides 24·44 eV, which is considerably more than the maximum of 19·39 required for the negative bands. Moreover, according to Kaplan's mechanism, a molecule in the G-K level would have to survive up to 10000 collisions. [See Abstract 5300 (1937).] G. C. E.

3672. Preparation and Properties of Auroral Afterglows. J. Kaplan. *Phys. Rev.* 54. *pp.* 176–178, *Aug.* 1, 1938.—The preparation of auroral afterglows in pure nitrogen is discussed in detail. A nomenclature is introduced for the five stages which are met most frequently in the preparation of these glows. In the normal order in which they occur they are the O_3, NO, CN, Lewis-Rayleigh, and finally the auroral stage. Two plates, one showing the spectrum of the discharge in pure nitrogen, which is responsible for the production of the auroral glow, and one which shows the spectra of the NO, CN and auroral stages, are reproduced. AUTHOR.

See also Abstracts 3695.

INTERFERENCE, DIFFRACTION AND SCATTERING.

3673. Theory of Intensity Anomalies in Diffraction. U. Fano. *Ann. d. Physik,* 32. 5. *pp.* 393–443, *July,* 1938.—While the intensity of a diffracted wave is in general a slowly variable function of the diffraction parameter, in many researches with optical and material waves anomalous intensity effects have been observed. Such anomalies, together with a series of allied anomalies from different realms of physics, are here discussed as far as possible from a common viewpoint. A formal mathematical development is in many cases far from simple and the final formulæ can only with difficulty be compared with experimental results, since the experimental conditions are not sharply enough defined to furnish accurately the initial data included in the theory. On this account the aim of the paper is directed to elucidating more the physical aspect and the inner nature of the phenomena in question, than developing mathematical theory. The various sections of the paper deal with (1) Wood's optical anomalies (historical). (2) Development of the Rayleigh-Voigt dynamic theory of the grating. (3) Wood's optical anomalies (discussion). (4) The anomalies of reflection and diffraction of molecular rays. (5) The connection between some diffraction anomalies for X-rays and electron rays (Kossel and Kikuchi lines and particularly Kikuchi envelopes). A. W.

3674. Concept of Degree of Coherence and its Application to Optical Problems. F. Zernike. *Physica,* 5. *pp.* 785–795, *Aug.,* 1938. *In English.*—The maximum visibility of the interferences obtainable from two points in a wave field is defined as their degree of coherence γ. By a simple statistical method general formulæ are found for deducing γ from illumination data. For any extended light-source γ is found equal to the amplitude in a certain diffraction image. It does not change by the use of a condensing lens, but depends only on the aperture of the illuminating cone. These properties are applied to the microscopic observation of objects in transmitted light. AUTHOR.

3675. Molecular Diffusion of Light by Liquids. Variation of Diffused Intensity with Wave Length. A. Rousset and R. Garnier. *Comptes Rendus,* 207. *pp.* 142–145, *July* 11, 1938.—Comparison of the variation of the intensity of the light diffused by benzene with that of CCl_4, acetic acid, and ethyl alcohol, by the method of photographic photometry, shows that, in the spectral range 3650 to 5460 Å, benzene follows the Vessot-King rule. The ratio of the existing absolute values of the intensity of light diffused by ether and by benzene agrees with that calculated from the Vessot-King rule and also shows that benzene obeys the rule. W. R. A.

See also Abstracts 3444, 3445, 3622.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

3676. Photolysis of H_2S. G. S. Forbes, J. E. Cline and B. C. Bradshaw. *Am. Chem. Soc., J.* 60. *pp.* 1431–1436, *June,* 1938.—Highly purified H_2S and HBr were photolysed successively in a rotating quartz cell. Assuming that one quantum produces one molecule of H_2 from HBr at 400 mm. the quantum yield of H_2S is 1·02 ± 0·05 molecules of H_2 per quantum. This quantum yield is independent of pressure over the range 8–1400 mm., and also of light flux (for 208 mμ). The mechanism of the photolysis is discussed. A. J. M.

3677. Action of U.V. Rays on Mercury Fulminate. A. Borocco. *Comptes Rendus,* 207. *pp.* 166–168, *July* 11, 1938.—The change of colour of mercury fulminate on exposure to u.v. radiation depends on the duration of exposure and on the intensity of the radiation. Measurements of the density and X-ray spectrum, and microscopical examination, show that the structure of the fulminate has not been affected. Exposure of mercury fulminate *in vacuo,* however, indicates partial decomposition to Hg, CO_2 and N_2. The total effect of exposure to u.v. radiation is thus analogous to that produced by heating. W. R. A.

3678. Photochemical Processes in Crystals. R. Hilsch and R. W. Pohl. *Faraday Soc., Trans.* 34. *pp.* 883–888 ; *Disc.,* 888–892, *Aug.,* 1938.—The authors deal with photochemical processes in solid solutions of the alkali halides and hydrides and the application of the electrical method of measurement, in which former difficulties have been overcome. In the *Discussion* : **N. F. Mott** attempts a mathematical description of the suggested process by which colour centres are produced in KBr containing KH or KD. **W. F. Berg** contributes a paper on the " Nature of the Latent Image Particles and of the Coloration in Silver Halide Crystals," in which, from the apparent analogy between the latent image and the particles producing the red coloration in single crystals of silver halides under the action of blue light, it is concluded that these particles consist of a few Ag atoms only, and that the coloration is due to a genuine absorption process and not to scattering of light. Berg opines that the absorption process is probably a photoelectric effect by which electrons are emitted from the Ag into the crystal. **F. Weigert** states that the best-supported assumption for the primary effect of light is that an electron is ejected from a Ag atom and caught suitably in its neighbourhood (*e.g.*, by a Ag ion) and in all directions round the Ag particle where it is in contact with the halide. In using polarised light the particle is peeled off preferentially at those faces which are parallel to the plane of polarisation, and an anisotropic particle is produced. If this hypothesis is proved to be correct the scattering and the absorption of red light are quite different phenomena. H. H. Ho.

3679. Primary Processes in Photodecomposition. M. Burton and G. K. Rollefson. *J. Chem. Phys.* 6. *pp.* 416–423, *Aug.,* 1938.—When energy is absorbed by a molecule at a particular bond by a process of transition to a repulsive energy level or a sufficiency high point on an attractive level, rupture always results within one vibration period. All other photodecomposition processes are properly included under the title of predissociation. Thus, rupture may also result at the locus of absorption as the result of either spontaneous or induced adiabatic transition from an attractive to a repulsive or "weakly attractive" level. These are the only mechanisms of predissociation in diatomic molecules. In polyatomic molecules, spontaneous or induced shifts of energy or rearrangements of groups, resulting in decomposition, may also occur. Illustrations of the various processes suggested are cited from the photochemistry of S, I, O_3 and the aldehydes. In the case of formaldehyde it has been possible to distinguish potential hypersurfaces and to indicate two different types of predissociation: one in a single hypersurface and the other a spontaneous transition between two hypersurfaces. The method used is extended to other aldehydes. Suggestions are made as to the interpretation of the photochemistry of several other substances and as to several problems which require solution. AUTHORS.

3680. Adsorption Theory of Photographic Development. A. J. Rabinovitch. *Faraday Soc., Trans.* 34. *pp.* 920–926; *Disc.*, 936–940, *Aug.*, 1938.—Discusses previously published results of investigations on the physico-chemical aspect of the process of photographic development. Two main lines are followed, one tending to give a quantitative description of this process as well as stating the laws governing it, the other attempting to explain the underlying mechanism. R. C. F.

3681. Gelatin for Photographic Use. A. P. H. Trivelli and W. F. Smith. *Zeits. f. wiss. Phot.* 37. *pp.* 123–129, *June*, 1938.—Critically examines the Russian proposal for standardising gelatin which is to be used for photographic purposes. It is concluded from experimental results given, that the standardisation suggested by the results of Makarov, Chibisov and Mikhailova is not sufficiently justified for practical use. R. C. F.

3682. Contrast and Number of Grains in Photographic Emulsions. A. P. H. Trivelli and W. F. Smith. *Zeits. f. wiss. Phot.* 37. *pp.* 140–146, *June*, 1938.—Shows that the direct proportionality between contrast and the number of grains/cc., suggested by Makarov, can only be approximately true within narrow limits. With a number of emulsions the contrast is proportional to the logarithm of the number of grains. If the least dense region be excluded it is found that an even better relationship is obtained by considering the contrast and the square root of the number of grains. R. C. F.

3683. Spectral Sensitivity of Photographic Layers. J. Eggert and M. Biltz. *Faraday Soc., Trans.* 34. *pp.* 892–901; *Disc.*, 908–912, *Aug.*, 1938.—The sensitivity of photographic AgBr layers has been measured as a function of the wave-length; the state of ripening, the AgI content, and dye sensitisation have been varied. The relations between AgBr and dye content, absorbed light quanta and developed density have been established quantitatively for a layer sensitised optimally for the green. The ideas which appear most probable at present regarding the mechanism of the photographic process are set forth on the basis of the present and of earlier experimental results: (*a*) The sensitivity of the AgBr is ascribed to *Störstellen* in the crystal lattice, the energy supplied to these zones leading to their photolayers and to the production of new *Störstellen* in the previously undisturbed AgBr crystal. (*b*) In the region of longer waves, from about 500 m.p. onwards, the magnitude of the sensitivity of unsensitised layers is essentially determined by the *Störstellen* only. The AgBr acts as an energy carrier in the region of its strong intrinsic absorption from about 500 mμ towards shorter wave-lengths.

(*c*) The substances, added to the photographic layers to increase the sensitivity particularly in the region of the longer waves, such as Ag-I and dye sensitisers especially, are also to be considered as energy carriers which give up the absorbed light to the *Störstellen*. [See following Abstract.] H. H. Ho.

3684. Photosensitisation by Solids. C. F. Goodeve and J. A. Kitchener. *Faraday Soc., Trans.* 34. *pp.* 902–908; *Disc.,* 908–912, *Aug.,* 1938.—The essential feature in a photosensitised as distinct from a direct photo-process is the transfer of the energy from the spot where it is absorbed to one where an emission of fluorescent radiation or a reaction, can take place. The authors now discuss this process in solids under three headings: (1) the light absorbing species; (2) the mechanism for the transference of the absorbed energy; (3) the potentially reactive (or fluorescent) centre. Sections are then devoted to fluorescent phosphors, photosensitisation by pigments, the photographic process (which may involve both direct and sensitised photo-reactions), and the degradation of the excitor to heat. In the *Discussion*: **W. E. Garner** dealt with the investigation of the nuclei formed by the action of light on crystals in which he had found there are a limited number of places at which such nuclei appear, and also that the thermal nuclei and those started by light are very largely independent of one another; **J. Weiss** considered the similar behaviour of ions in solution to ions in ionic crystals; **J. Boulton** suggested further definite experiments on the bleaching of sky blue FF on TiO_2; and **T. H. Morton** criticised the exciton hypothesis. Morton's criticism is comprehensively dealt with by the authors in their reply. [See preceding Abstract.] H. H. Ho.

3685. New Time Phenomenon in Photographic Emulsions. F. Weigert. *Faraday Soc., Trans.* 34. *pp.* 927–930; *Disc.,* 936–940, *Aug.,* 1938.—The photodichroism produced on an oblique film of AgCl gelatin by the combined action of beams of natural light of blue and red colour when plotted against the spectrum was the more positive as the length of the dark time interval elapsing between a blue and red exposure was increased. A dark interval following a red exposure had no perceptible influence. It is suggested that this is due to the production, by the action of the blue light, of a sensitiser for red which slowly loses its activity. AUTHOR.

3686. Photographic Sensitivity. Lüppo-Cramer. *Faraday Soc., Trans.* 34. *pp.* 930–935; *Disc.,* 936–940, *Aug.,* 1938.—The statements in the literature that pure dry silver halides are not photographically sensitive at all (that is, without development) are mutually contradictory and should therefore be tested. The main part of the sensitivity of ordinary photographic plates in any case arises from the germs. With layers quite free from binding material the sensitivity decreases with increasing grain size, since the smaller grain is more easily accessible to purely chemical reduction by the developer. These relationships are reversed with gelatin-AgBr since here the protective action of the colloid is decisive and this is more effective with small grains than with larger ones. The optically measurable light-absorption constitutes no measure for the light-sensitivity since only the *chemical* absorption is decisive for the utilisation of the radiant energy and the former is for its part greatly influenced by the internal reversal phenomena. Even the penetrating energy of X-rays does not result in a uniform distribution of the latent image over the whole grain, so that even the X-ray image is for the most part concentrated on the grain surfaces, as is manifest from the behaviour towards desensitising dyes and oxidising agents. Other reversal phenomena and their significance for photographic sensitivity are discussed. AUTHOR.

3687. Influence of Partial Grain Solution on Developable Blackening. G. Ungar. *Zeits. f. wiss. Phot.* 37. *pp.* 130–139, *June*, 1938.—Discusses the previously published work of Kempf on the topography of the latent image [see Abstract 5313 (1937)] and shows that his conclusions on the distribution of the latent image are incorrect. A new explanation for the shape of the curve connecting grain size with blackening, and obtained with physical development, is given, the shape of the curves obtained with chemical development being also discussed. Finally, the relationship between mean grain radius and the number of grains is mathematically developed in an appendix. R. C. F.

3688. Latent-Image Formation, Reciprocity Law Failure at Low Temperatures. J. H. Webb and C. H. Evans. *Kodak Research Lab., Comm. No.* 674. *J.O.S.A.* 28. *pp.* 249–263, *July*, 1938. *Sci. et Ind. Phot.* 9. *pp.* 257–266, *Sept.*, 1938.—The results are given of experiments to test the theory of latent-image formation proposed by Gurney and Mott, who introduced the concept of electrolytic transportation of Ag^+ ions to account for the nucleation of latent image Ag about the sensitivity specks pre-existent on the surface of the grains. The Ag^+ ions diffuse to the specks under the attraction of electrons trapped there during the exposure to light. The first experiment consisted of a series of intermittent exposures made at liquid air temperature with warm-up periods between flashes, and the results indicate that something vital to the photographic process takes place during the warm-up period between exposures. The second experiment consisted of a series of Herschel exposures made under a variety of temperature conditions. The results obtained are radically different under the different conditions. It is found that the low-intensity reciprocity law failure has disappeared at -78° C. and that the high intensity failure has practically disappeared at -186° C. All of the results are shown to have ready interpretation on the Gurney-Mott picture of latent-image formation. A. H.

3689. Mechanism of Photographic Reversal. G. W. W. Stevens and R. G. W. Norrish. *Phot. J.* 78. *pp.* 513–529; *Disc.*, 529–533, *Aug.*, 1938.—The Sabattier effect is investigated experimentally and it is found that the reversal is concerned only with grains not affected by the first exposure and that it is produced with very short first developments. The log. desensitisation is found to be directly proportional to the first developed density only if the latter be varied by changing the first exposure; metallic silver (because of its deposition on the unexposed grains in the vicinity of the latent image during the first development) is thought to be the probable cause of the desensitisation. This conception is used to predict new facts about the Albert effect. The desensitisation is probably concerned with the function of the ripening nuclei. A. H.

3690. Physical Development of the Latent Image. W. Reinders and M. C. F. Beukers. *Faraday Soc., Trans.* 34. *pp.* 912–919; *Disc.*, 936–940, *Aug.*, 1938.—On account of the good results obtained by the authors with the physical development of the latent image according to Odell, investigations with respect to the physical development were undertaken. A strong Eberhard-effect occurs, which causes increase of contrast in lined figures, since the density of the lines in the negative is more intense than that of an equally strongly exposed large area. At equal line density the broadening of the lines, due to diffuse dispersion in the emulsion, is less than the chemical development. In the usual neutral developers for physical development which contain Na_2SO_3 and $Na_2S_2O_3$, the difference ΔE between the Ag potential and the reduction potential is 100 to 170 mV, *viz.*, considerably lower than in the solutions for rapid chemical development, and somewhat lower than in the slow-acting fine grain developers. In the solutions where $\Delta E = 100$ mV, the spontaneous formation of Ag is considerably less than in the solutions with higher ΔE. The Ag potential in the solutions may be varied within wide limits by changing the relation $AgNO_3 : Na_2S_2O_3$. AUTHORS.

3691. Photography and Kinematography of the Emission of the Scent of Flowers. H. Devaux. *Soc. Franç. Phot. et Ciné., Bull.* 25. *pp.* 109–111, *July,* 1938.—Briefly describes two methods whereby it has been possible to photograph the emission of scent from various flower petals. In the first method the flower petal is held very close to a Hg surface dusted over with talc powder, the powder moving progressively outwards, due to the flower scent, until a circle of 10 to 15 cm. dia. is obtained. The other method, which is more simple and sensitive, consists of holding the petal within 2 or 3 mm. of a clean Hg surface, and then, after 5 mins., covering the mercury surface with a thin film of moisture, when a stain appears due to the scent fixed on the Hg. R. C. F.

See also Abstracts 3742.

PHOTOMETRY.

3692. Problems in Heterochromatic Photometry. H. König. *Helv. Phys. Acta,* 11. 5. *pp.* 432–460, 1938. *In German.*—The problems treated by the author are (i) the determination of the luminosity (visibility) curve by means of a limited number of observations using an approximate curve as basis and the measurement of a number of colour filters, (ii) the establishment of a combination blue filter to change one black-body temperature to another, (iii) the approximation of the spectral transmission curve of a combination filter to the luminosity (visibility) curve of the eye. The problems are attacked by the method of successive approximations. J. W. T. W.

3693. Photometry of Coloured Light Sources. W. E. Forsythe, B. T. Barnes and A. L. Shrider. *J.O.S.A.* 28. *pp.* 241–248, *July,* 1938.—Describes an investigation of the variations between different observers when measuring coloured light sources, such as Hg and Na discharge lamps and various fluorescent lamps, using different types of photometer heads. Colour filters were used to obtain an approximate match in the photometer field of a Lummer-Brodhun head with (*a*) a large field (8–10°) and (*b*) a small field (2°). Then the results obtained with an Ives-Brady flicker photometer were compared with those given by direct comparison. Full details of the screens used and of the Y/B ratios of the observers are given. Finally the relative luminosities of the yellow and green Hg lines were found for 18 observers using the flicker photometer, and the average ratio found, 1·360, agreed well with that calculated from the I.C.I. visibility data. J. W. T. W.

3694. Spectral Luminosity Curve of the Eye. A. Dresler. *Zeits. f. techn. Physik,* 19. 7. *pp.* 206–212, 1938.—The investigations which culminated in the adoption in 1924 of a standard spectral luminosity curve

of the eye are reviewed. The results of certain later workers are then examined which seem to show (*a*) that when unexceptionable light-adaptation is secured the luminosity curve obtained by the flicker or small-steps direct comparison methods is shifted slightly towards the red with respect to the standard curve, and (*b*) that in direct heterochromatic comparisons with unrestricted colour differences the additive law breaks down. The need for further determinations of the luminosity curve by different workers having regard to these effects is stressed.
W. S. S.

See also Abstract 3746.

POLARISATION.

3695. Fundamental Polarisation and Temperature. A. Jabłoński. *Acta Physica Polonica*, 7. 1. *pp*. 15–23, 1938. *In German*.—Polarisation measurements have been made of the fluorescent light of certain dye-adsorbates and of a strong solution of fluorescein in alcohol. The degree of polarisation of the alcoholic fluorescein solution at −110° to −148° is the same as for a glycerol solution at room-temperature. The dye-adsorbates also give values independent of temperature. It is concluded, therefore, that the degree of polarisation is not dependent on temperature in contradiction to Cahen's results. Differences in the degree of polarisation with temperature were observed when the alcoholic solution of fluorescein was examined at −170° C. but this is not significant since all solutions show variable values with time at constant temperature.
W. R. A.

3696. Optical Properties of Stratified Cholesteric Substances. J. P. Mathieu. *Comptes Rendus*, 206. *pp*. 1890–1891, *June* 20, 1938.—The changes in wave-length, λ, and the polarisation caused by transmission through, and diffusion by films of various esters of cholesterol 1–50 μ thick, were determined as functions of λ, in detail in the cases of the propionate and cinnamate, and sufficiently to show the phenomena to be similar in those of the butyrate, pelargonate, caprate and benzoate. Light of a given λ diffused normally to the film forms a band of width 20 μ, and is circularly polarised. Transmitted light is usually polarised elliptically, but for a certain thickness circularly (10 μ and 20 μ for the cinnamate and propionate respectively). The rotatory power of these esters varies from 500° to 10,000° mm. according to λ and the ester. A magnetic field of 15,000 gauss has no effect. C. A. S.

See also Abstracts 3470, 3685, 3699.

REFLECTION, REFRACTION AND DISPERSION.

3697. Reflection Coefficient of Mercury. R. C. Mason. *J. of Applied Physics*, 9. *pp*. 535–539, *Aug*., 1938.—Two new methods for measuring the reflection coefficient of Hg atoms from a Hg surface are described. In the first, a micromanometer gives both the change in pressure on the surface, and the subsequent rate of evaporation, when a Hg pool is exposed to an opposing liquid-air cooled condensing target. From these, reflection coefficients from 0·93 to over 0·99 are obtained. In the second, from measurement of the vapour density between evaporating and condensing surfaces by an ionisation gauge, the reflection coefficient can be calculated. With careful purification of the mercury, quite small reflection coefficients result, a mean of 0·2, and a minimum of

0·07 being found. Exposure of the Hg surface to the atmosphere for half an hour brings the reflection up to 0·8, while after 10 days' exposure the reflection coefficient becomes 0·92. AUTHOR.

3698. Adjustments and Measurements by Means of Images Obtained by Multiple Reflections. A. Guillet. *Comptes Rendus,* 207. *pp.* 61–63, *July* 4, 1938.—First-order images obtained by double reflection from two mirrors, one spherical and the other plane, are discussed theoretically. W. R. A.

3699. Wave and Geometrical Optics. S. M. Rytov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 4–5. *pp.* 263–266, 1938. *In French.*—By applying to the equation of a wave the approximation in reference to wave-length of geometrical optics the conservation of light flux is demonstrated and a law for the rotation of the vectors (polarisation) is deduced. H. G. C.

3700. Influence of Strain on Refractive Index of Glass. N. Winter-Klein. *Comptes Rendus,* 206. *pp.* 1627–1629, *May* 30, 1938.—The relative magnitudes of the influences of mechanical strain and structural transformation on the values of the refractive index of glass, annealed at different temperatures, have been investigated. W. R. A.

***3701. Relative Refractive Index of Two Liquids by Photography. H. O. Kneser.** *Zeits. f. Instrumentenk.* 58. *pp.* 276–278, *July,* 1938.—The author describes an arrangement which measures the ratio of the refractive indices of two liquids photographically. The liquids are contained in two cells of plane glass, one inside the other. The inner cell is tilted against the outer about an axis perpendicular to the optical axis of the system. The light of a small electric bulb enters the two cells, collimated by a lens, and is reflected by a plane mirror which is arranged inside the inner cell. The image is focused by a cylindrical lens on the lens of a spectrograph. The photographs show a curved line whose distance from any line parallel to the edge of the spectrum is measured. The author has derived a formula which relates this distance to the angle of tilt, the focal length of the lens and the ratio of the refractive indices. The method can be used for u.v. and infra-red light as well as for the visible region. L. K.

3702. Refractive Index of Air in the Visible and Photographic Infra-Red. D. Bender. *Phys. Rev.* 54. *pp.* 179–183, *Aug.* 1, 1938.—The refractive index of dry CO_2-free air has been measured from 5300 to 11177 Å by means of a Fabry-Perot interferometer with invar separating posts. The following dispersion curve was obtained for standard conditions (λ in microns): $(n_0 - 1)\,10^7 = 2885\cdot59 + 15\cdot77/\lambda^2 + 0\cdot421/\lambda^4$. A comparison of the present results with those of other observers shows that this curve is higher by about 10 parts in 10^7, and that all curves are nearly parallel. This suggests that the discrepancies are due to systematic errors providing, as seems to be the case, that the constitution of air remains sufficiently constant. In the present experiments systematic errors due to phase change at reflection, methods of purification of the air, and bulk modulus of the invar posts were considered. A calculation concerning the oxygen absorption band at 7600 Å indicates that this band has no measurable effect on the dispersion of air. AUTHOR.

See also Abstracts 3468, 3572, 3718.

SPECTROSCOPY.

3703. Spectroscopy in Industry. G. R. Harrison. *Frank Inst., J.* 226. *pp.* 1–17, *July,* 1938.—This article is devoted to a survey of the uses to which spectrum analysis may be put and a detailed examination of the methods employed in certain cases. A. H.

3704. Spectrum of Neutral Iridium, IrI. W. Albertson. *Phys. Rev.* 54. *pp.* 183–184, *Aug.* 1, 1938.—A new description of the arc spectrum of Ir has been made. The present data include 3100 wave-lengths of which 1937 have been accounted for as combinations between 214 energy levels. The normal electron configuration of the Ir I is $5d^7 6s^2$ and the I.P. is approximately 9·2 V. Tables of the most intense lines and of all the energy levels are presented. AUTHOR.

3705. Arc Spectrum of Silicon. C. C. Kiess. *Bureau of Standards, J. of Research,* 21. *pp.* 185–205, *Aug.*, 1938.—A new survey has been made of the spectrum emitted by neutral Si atoms. Revised wave-lengths and intensities are given for 400 lines between 1565 Å in the u.v. and 12270 Å in the infra-red. The fine structure of some red and infra-red lines that appear diffuse when emitted by the arcs in air has been resolved by enclosing the light source in an atmosphere of N_2 at reduced pressure. Nearly all the lines have been classified as combinations between known and new singlet and triplet terms required by atomic theory. These terms belong to various series of three or more members each and yield accordant results for the value of the ground state $3p\ ^3P_0$ of Si I. This value, 65743 cm^{-1}, corresponds to an ionisation potential of 8·11 V. Most of the observed Si lines longer than 3000 Å and many that are not emitted in the arc but are predictable from the terms, correspond to faint Fraunhofer lines heretofore unidentified. [See also Abstract 636 (1934).] AUTHOR.

3706. Arc and Spark Spectra of Tungsten. D. D. Laun. *Bureau of Standards, J. of Research,* 21. *pp.* 207–224, *Aug.*, 1938.—The new large quartz-prism spectrograph of the National Bureau of Standards has been used to photograph the arc and spark spectra of tungsten in the u.v. between 3100 and 2100 Å. The wave-length data derived from these observations and also the Zeeman effect observations made with the same instrument, have made it possible to establish the low terms ^6D and ^6S of W II, together with several other metastable terms whose identity is not yet certain. The *raie ultime* of W II is probably the intense line at 2204·49 Å. In W I 89 new levels have been found. The *g*-values, derived from new Zeeman effects, are given for 37 levels of W I. AUTHOR.

3707. Hydrogen and Deuterium Balmer Series. V. Černiaev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 4. *pp.* 243–248, 1938. *In English.*—A comparison is made of the emission of light by the two H isotopes under different conditions with a view to interpreting the nature of the elementary processes in the discharge. A mixture of the isotopes was used and the ratios of the intensities of the series measured under different pressure conditions and with different foreign gases present. The results are discussed at length. A. H.

3708. Hyperfine Structure of Zeeman Components of Resonance Lines of Sodium. D. A. Jackson and H. Kuhn. *Roy. Soc., Proc.* 167*A*. *pp.* 205–216, *Aug.* 5, 1938.—The hyperfine structure of the Zeeman π components of the two resonance lines of Na was observed by means of the absorption in an atomic beam, the high resolving power instrument being a double etalon with separations of 2 and 8 cm. In strong fields, each Zeeman component was found to possess four hyperfine structure components, proving with certainty that the nuclear spin of Na is 3/2. The alteration in the spacings of the lines as the field strength was changed from 3060 to 790 gauss was found to be in excellent agreement with that predicted by quantum mechanics. A direct determination of the hyperfine structures of the terms $3S_{\frac{1}{2}}$ and $3\,^2P_{\frac{1}{2}}$ was made from the complete resolution of the line 5896. AUTHORS.

3709. Hyperfine Structure of the Forbidden Hg Line 2655·8 Å (6^3P_0–6^1S_0) W. Opęchowski. *Zeits. f. Physik*, 109. 7–8. *pp*. 485–490, 1938.—The hyperfine structure of this line has been measured by Mrozowski [see Abstract 1641 (1938).] This structure shows that the explanation of the appearance of this forbidden line, which rests on the interaction between the nuclear magnetic moment, and the electrons, is correct, and so far this is the only forbidden line for which this explanation has been shown to be correct. In this paper the intensity-ratios of the hyperfine structure components are calculated, and the ratio of their total intensity to that of the resonance-line 2537 Å. The calculated and observed values are in good agreement. A. C. M.

3710. Absorption of the CH_2 Group in the Region of 3μ. J. J. Fox and A. E. Martin. *Roy. Soc., Proc.* 167A. *pp*. 257–281, *Aug*. 5, 1938.—The absorption of seven substances containing CH_2 groups has been investigated in the region of 3μ. Besides the aromatic CH bands found about 3·27μ when a benzene ring is present, two or more bands near 3·4μ are attributable to the CH_2 groups. A critical survey of the data available for C_2H_4 enables us to explain the bands observed for CH_2 groups in more complicated molecules. When only one CH_2 group is contained in the molecule, two bands are observed and these are identified as the CH valency vibrations in and out of phase but when the number of CH_2 groups is increased, the coupling between them may increase the number of bands as in dioxane, for example, where four strong bands are observed. A satisfactory approximation to the molecules studied by us is found in a model of the formaldehyde type in which the CH_2 group is attached to a mass of similar magnitude. This model enables us to explain the observed frequencies provided that the CH force constant is $4{\cdot}52 \times 10^5$ dynes/cm., a value considerably lower than $5{\cdot}02 \times 10^5$ for C_2H_4 and $5{\cdot}88 \times 10^5$ for C_2H_2. The important result is obtained that the mass to which the CH_2 group is attached and the various other force constants involved in compounds of the type investigated have very little effect on the positions of the CH_2 absorption bands in the 3μ region, except in rare cases involving strain of the bonds connecting the CH_2 groups to the rest of the molecule, *e.g.*, fluorene. AUTHORS.

3711. Infra-Red Absorption of Thionyl Chloride. S. Vencov and D. Stefăneşcu. *Soc. Roumaine de Physique, Bull.* 39. 71. *pp*. 13–20, 1938. *English Abstract*.—The authors have studied the infra-red absorption bands of $SOCl_2$, between 1 and 9μ. The paper contains a discussion upon the two possible forms of the molecule, the plane and the tetrahedral. These bands are explained by a pyramidal molecular shape. The observed frequencies enable the order of magnitude of the dimensions of this molecule to be determined. AUTHORS.

3712. Influence of Temperature on the Absorption Spectrum of Cadmium Vapour. T. Zamlyński. *Acta Physica Polonica*, 7. 1. *pp*. 24–33, 1938. *In German*.—The u.v. absorption spectrum of Cd vapour has been investigated. The fluctuation bands (2800 to 2590 Å) have been studied from 580° to 870° and become more diffuse at higher temperatures. The existence of two band groups reported at 3170 and 3070 Å has been confirmed. Two new groups at 3072—2977 Å and at

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19

2840—2800 Å are reported; the origins of these have not been established. W. R. A.

3713. Absorption of Gaseous CS_2 in the Schumann Region. E. Hauptman. *Acta Physica Polonica,* 7. 1. *pp.* 86–94, 1938. *In German.*—By measuring the absorption bands in the Schumann region the normal vibrations of the CS_2 molecule have been found. They agree well with the determinations from Raman effect, but the frequencies of the optically active vibrations differ slightly from what measurements in the infra-red spectrum had suggested. R. P.

3714. Absorption Spectra of the Pyrrol Dyestuffs. Part II. A. Stern and F. Pruckner. *Zeits f. phys. Chem.* 182. *Abt.A.* 2. *pp.* 117–126, 1938.—This paper continues previous work [see Abstract 4528 (1937)] and describes the absorption spectra of stercobilin and stercobilin-hydrochloride which have been measured in dioxane and in alcohol for comparison with the spectra of Urobilin IXa and Urobilin IXa-hydrochloride in the same solvents. The spectra while similar nevertheless indicate clearly that the above substances are not identical, and that the influence of solvent upon absorption is not great. The spectra of stercobilin and of its hydrochloride correspond in type to the spectra of pyrromethene and its hydrochloride, so that the presence of a pyrromethene structure in the former compounds would appear to be established. The spectra also indicate the number of pyrromethene chromophores in a bilirubinoid. The absorption spectra of the stercobilin-chloroform compound belongs to the type given by the hydrochlorides of bilirubinoids, and it is concluded that the chloroform is united to the N atom of the pyrrolenin nucleus of the pyrromethene-chromophore and thereby produces a similar effect on light absorption to that of salt formation. H. H. Ho.

3715. Spectra of H_2O in Dioxane and Pyridine. G. S. Landsberg and V. S. Malyschev. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 8. *pp.* 549–551, 1938. *In French.*—In previous work on the effect of density decrease on the spectrum of H_2O the decrease has been attained by heating or evaporating. This does not enable the mechanism of the effect to be investigated. Dilution in dioxane surrounds H_2O with molecules of low electrical moment but containing O. Dilution with pyridine introduces molecules of appreciable electric moment and no O. On dilution with dioxane the band (3460 cm^{-1}) moves to higher frequencies and becomes double (the effect produced by heating). Dilution in pyridine leaves the position of the band unchanged but narrows it. H. G. C.

3716. Absorption Spectra of Praseodymium and Neodymium in D_2O. S. M. Katchenkov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 8. *pp.* 557–558, 1938. *In English.*—A study is made of the absorption spectra of praseodymium and neodymium sulphate solutions in D_2O. The use of D_2O, as compared with H_2O is to shift the absorption bands to the short-wave side and to produce a slight change in the structure of the bands. The effect of change of temperature in the two cases is accounted for as being due to the different physical and chemical properties of heavy and ordinary water. It is also observed that the dissolution of neodymium sulphates in D_2O proceeds more slowly and gives a brighter colour than in H_2O. A. H.

3717. Absorption Spectra of Chrome Alum Containing D_2O. H. Böhm. *Ann. d. Physik,* 32. 6. *pp.* 521–536, *July,* 1938.—The author has investigated the absorption spectra of chrome alum containing H_2O

and D_2O of crystallisation at different temperatures. The crystals which contain D_2O, show a displacement of the lines of about 60 cm^{-1} as compared with the spectra of the ordinary crystals. For some diffuse lines the shift is so great that it is not possible to assign the lines. The intensity of the continuous spectrum is greatly weakened in the blue for D_2O. The systematic shift of the lines makes it probable that the diffuse lines are caused by a superposition of vibrations on the electronic frequencies. L. K.

3718. Visible and U.V. Reflection Spectra of Solids. M. Billy and A. Berton. *Comptes Rendus,* 206. *pp.* 1631–1634, *May* 30, *and pp.* 1958–1960, *June* 27, 1938.—The classification of reflection spectra from polished and rough surfaces is discussed. Reproductions of the spectra of about 30 compounds are given and their characteristics noted. It is claimed that such spectra can be applied successfully to the elucidation of the molecular structure of solids and to problems of polymerisation and dehydration. The experimental arrangement, the influence of particle size, and the method of reflecting the light are discussed. The method can be applied to investigate the molecular constitution of solids which cannot be studied by transmission methods. W. R. A.

3719. Band Spectra of CaI_2, SrI_2 and BaI_2. P. Mesnage. *Comptes Rendus,* 206. *pp.* 1634–1635, *May* 30, 1938.—The spectra of CaI_2, (4180–4380Å), SrI_2 (4250–4480 Å), and BaI_2 (5360–5610 Å) have been analysed; all the bands arise from the diatomic molecules, CaI, SrI, and BaI. The bands of CaI_2 comprise a series of 38 bands and are degraded towards the red. Each band appears as a small doublet. For CaI_2 there is no indication of two systems of bands with a constant frequency separation. SrI_2, on the other hand, has two systems; one of 26 bands resembling those of CaI_2 and the other of 40 simple bands. Both systems have a lower level in common but different upper levels. BaI_2 has two systems with a separation of 755 cm.$^{-1}$ and the sequences are degraded towards the violet. W. R. A.

3720. Absorption Spectra of Coordination Compounds. Part II. R. Tsuchida. *Chem. Soc. Japan, Bull.* 13. *pp.* 436–450, *June,* 1938. *In English.*—Two of the three absorption bands generally met with in the case of a metallic complex have been attributed to electron transitions in an unsaturated transition shell of the central ion [see Abstract 3268 (1938)]. In the present work the origin of the third band is discussed as well as the relation between the absorption and stability of the complex radical. A. H.

3721. Absorption Spectra and Configuration of Complex Salts. Part II. H. Sueda. *Chem. Soc. Japan, Bull.* 13. *pp.* 450–452, *June,* 1938.—*cis*-$[Co(NH_3)_3(NO_2)_3]$ was prepared and its absorption band proved identical with that expected [see Abstract 3592 (1937).] AUTHOR.

3722. Variation of U.V. Spectrum of Naphthalene with pH. M. Gex. *Comptes Rendus,* 207. *pp.* 153–155, *July* 11, 1938.—The u.v. spectrum of $C_{10}H_8$ as a function of pH has been investigated. The results make it probable that $C_{10}H_8$ in H_2O behaves as an ampholyte. A. J. M.

3723. Infra-Red Absorption Spectrum of CD_4. A. H. Nielsen and H. H. Nielsen. *Phys. Rev.* 54. *pp.* 118–121, *July* 15, 1938.—The spectrum of CD_4 has been measured from $3\cdot0\ \mu$ to $10\cdot5\ \mu$ and three regions of absorption were observed. These bands with centres at $2992\cdot8$ cm^{-1}., $3103\cdot7$ cm^{-1}., $2259\cdot0$ cm^{-1}., and $995\cdot86$ cm^{-1}. have been identified as $\nu_1+\nu_4$, $\nu_3+\nu_4$, ν_3, and ν_4 by analogy with CH_4. The line spacings obtained from these bands in CD_4 are $\Delta\nu_{\nu_1+\nu_4} = 7\cdot17$ cm^{-1}.; $\Delta\nu_{\nu_3+\nu_4} = 5\cdot01$ cm^{-1}., $\Delta\nu_3 = 4\cdot52$ cm^{-1}.; $\Delta\nu_4 = 3\cdot42$ cm^{-1}. as compared with $5\cdot3$ cm^{-1}., $13\cdot5$ cm^{-1}., $9\cdot77$ cm^{-1}. and $5\cdot41$ cm^{-1}. for the same bands in CH_4. Values for the ζ's of Johnston and Dennison have been obtained and are as follows: $\zeta_3 = 0\cdot1465$ and $\zeta_4 = 0\cdot3535$. Utilising the line spacings given above and the expression $\Delta\nu_3+\Delta\nu_4 = 3h/8\pi^2A$ derived by Johnston and Dennison the value $1\cdot044\times10^{-39}$ gm.cm^2. is obtained for the moment of inertia A. AUTHORS.

3724. Spectra of NiCl, CoCl and FeCl. K. R. More. *Phys. Rev.* 54. *pp.* 122–125, *July* 15, 1938.—Emission spectra in the region 3800 to 6000 Å which are attributed to the molecules NiCl, CoCl and FeCl have been excited by means of h.f. discharges in silica tubes containing $NiCl_2$, $CoCl_2$ and $FeCl_2$, respectively. Vibrational analyses of four systems of NiCl and three systems of CoCl are given. No regularities were found among the FeCl bands. AUTHOR.

3725. Vacuum U.V. Absorption Spectra of Halogen Acids. W. C. Price. *Roy. Soc., Proc.* 167*A*. *pp.* 216–227, *Aug.* 5, 1938.—The absorption spectra of HI, HBr and HCl have been investigated in the vacuum ultra-violet. The bands observed are due to the excitation of a non-bonding $np\pi$ electron and are the strong resonance bands approaching the $^2\Pi_{1\frac{1}{2},\frac{1}{2}}$ states of the molecular ion. They start at 1762, 1491 and 1331 Å for HI, HBr and HCl respectively. In the case of HI a well-developed Rydberg series of bands was found approaching the $^2\Pi_{\frac{1}{2}}$ state of HI^+, the limit of which corresponded to $10\cdot990\pm0\cdot005$ V. It was not possible to establish with certainty Rydberg series going to $^2\Pi_{1\frac{1}{2}}$ of HI^+ or to any of the $^2\Pi$ states of HBr^+ or HCl^+. However, from correlations made amongst the bands of the different acids and with the corresponding transitions in the methyl halides, the mean ionisation potentials (*i.e.*, $HX : {}^1\Sigma \rightarrow HX^+ : {}^2\Pi$) are determined to be $10\cdot71$, $12\cdot04$ and $12\cdot84$ V for HI, HBr and HCl respectively, the probable error being about $0\cdot1$ V. AUTHOR.

3726. Kinetics of OH Radicals as Determined by Their Absorption Spectrum. Part III. Quantitative Test for Free OH; Probabilities of Transition. O. Oldenberg and F. F. Rieke. *J. Chem. Phys.* 6. *pp.* 439–447, *Aug.*, 1938.—(1) In order to make the OH absorption bands applicable to a *quantitative* chemical test for free OH their probability of transition (f value) was measured by the concentration of "dispersion electrons" in a known concentration of OH. (2) This concentration of OH is produced by water vapour dissociated at 1473° C., the equilibrium of which was computed. (3) The concentration of the "dispersion electrons" was measured by photometry of the absorption lines photographed with high resolving power. (4) The f values of the various absorption lines are given in a table. The most intense lines have f values of the order of magnitude 2×10^{-4}. The accuracy is estimated to be 15%, the sensitivity (smallest detectable pressure under the conditions of the present experiment), $0\cdot01$ mm. (5) Comparison with other f values leads to the conclusion that the OH absorption band belongs to a half-forbidden transition. The lifetime of the excited state is computed as approximately 4×10^{-6}. [For Part II see Abstract 698 (1937).] AUTHORS.

3727. CdF Spectrum. R. W. B. Pearse and A. G. Gaydon. *Phys. Soc., Proc.* 50. *pp.* 711–713, *Sept.* 1, 1938.—The spectrum observed by Asundi, Samuel and Zaki-uddin [see Abstract 1156 (1935)] and attributed by them to CdF, has been identified with the known spectrum of CaF. New experimental work with CdF is briefly described. Mention is also made of absorption bands incorrectly attributed to CdBr and CdI. AUTHORS.

3728. Presence of Infra-Red Adsorption Band $(\mathrm{OH})_e$ in the Intramolecular Hydrogen Bond. R. Freymann. *Comptes Rendus*, 206. *pp.* 1812–1814, *June* 13, 1938.—Contradictory evidence regarding the absence of the $(\mathrm{OH})_e$ band characteristic of free molecules, *i.e.*, molecules containing intramolecular H bonds, *e.g.*, salicylaldehyde and acetylacetone, is in opposition to the theory proposed by the author that chelation, keto-enol isomerism, molecular association, etc., have a common origin in H bonds and that the bonds may be intra- or inter-molecular. Examination of spectra between 0·8 μ and 1·2 μ confirms the common origin of the intra- and inter-molecular bonds and demonstrates that the $(\mathrm{OH})_e$ band appears in intramolecular as well as in intermolecular compounds. The $(\mathrm{OH})_e$ band is not shown by intramolecular compounds. W. R. A.

3729. Attribution of Band Lines to Causes Other than Rotation. H. Deslandres. *Comptes Rendus*, 206. *pp.* 1844–1848, *June* 20, *and* 207. *pp.* 7–11, *July* 4, 1938.—In previous papers [see Abstract 2900 (1938)] the vibration and rotation frequencies of molecules have been expressed in terms of a universal constant *d*, and the number of electrons involved. For H_2O the strongest absorption (vibration) is a harmonic of all the arithmetical series of rotation frequencies. The rule is supposed to be general and is illustrated by four cases. The results are extended to $Zn(C_2H_5)_2$ and $CH_3.CH : CH.CO.N(CH_3)_2$. It is concluded that the relationship between the frequencies of the molecule and the activated levels of the atoms is such that the radiations emitted by different parts of the molecule are the same or only slightly different. H. G. C.

3730. Mean Absorption and Equivalent Absorption Coefficient of a Band Spectrum. W. M. Elsasser. *Phys. Rev.* 54. *pp.* 126–129, *July* 15, 1938.—The note deals with the absorption of a band in which the lines have the dispersion form; the effect of the overlapping of neighbouring lines upon the absorption is taken into account. The analytical problem can be solved for a periodic pattern of lines with equal intensity S, width 2α and distance d from each other. Simple expressions are derived for the limiting cases of small and large α/d. In the latter case the transmission by a layer of thickness x is given by $I = I_0 e^{-(Sx/d)\tanh(2\pi\alpha/d)}$. It appears that this formula gives a fairly good mean approximation even for small values of α/d, while the true transmission in this case is not exponential. It is shown that in problems of radiative transfer and radiative equilibria this approximate formula for the transmission can be used; *i.e.*, the factor of x in the above exponent may be substituted in the equations of transfer as equivalent of a mean absorption coefficient. AUTHOR.

***3731. Production of Continuous Spectra by Electrical Excitation of Rare Gases. White Light. M. Laporte.** *J. de Physique et le Radium*, 9. *pp.* 228–236, *June*, 1938.—An experimental arrangement for the electrical excitation of rare gases to give continuous emission spectra is described. The influence of the nature of the gas and of the diameter of the tube are discussed. Distribution of spectral energy is considered and possible applications are suggested. [See also Abstract 3605 (1937).] W. R. A.

3732. Continuous U.V. Absorption Spectrum of Iodine Monochloride. J. L. Binder. *Phys. Rev.* 54. *pp.* 114–117, *July* 15, 1938.—It is shown that the absorption of light in ICl gas follows Beer's law, at least up to the concentrations used here, namely 4×10^{-4} mole/l. The absorption coefficients of ICl were measured at a number of wave-lengths and at several temperatures in the u.v. continuous band and the partial absorption coefficients derived from them. The effective amplitude of vibration of the electron producing this band was determined from the absorption coefficient curves. An attempt to measure the dissociation of ICl spectrophotometrically showed that the visible continuous band and the ultra-violet continuous band broadened out at high temperature to overlap completely the continuous u.v. band of Cl_2. AUTHOR.

3733. Zeeman Effect of an Abnormal Series of Argon. P. Jacquinot. *Comptes Rendus,* 206. *pp.* 1635–1638, *May* 30, 1938.—The series p^5ns of A shows important anomalies; only the $4s$ and $5s$ terms are interpretable on Houston's theory [see Abstract 2483 (1929)]. Coincidence of the levels $7s_2$ and $8s_4$ had been predicted but an examination of the Zeeman effect has not confirmed this. A small Paschen-Back effect between $7s_2$ and $7s_3$ is reported. W. R. A.

3734. Accuracy of Linear Law in Simple Cases of Zeeman Effect. P. Jacquinot. *Comptes Rendus,* 206. *pp.* 1960–1963, *June* 27, 1938.—An appreciable Paschen-Back effect is observed at 45,000 gauss for the 4680 and 4722 Å lines of Zn and for the 6334 and 6383 Å Ne lines. The linear law is obeyed to approximately 1 in 1000. No Kapitza effect is discernible at 45,000 gauss. W. R. A.

3735. Axiality of Emission of Light from the Hydrogen Atom in an Electric Field. J. Stark, R. Ritschl and H. Verleger. *Phys. Zeits.* 39. *pp.* 503–517, *July* 1, 1938. *From the Reichsanstalt.*—The Stark effect components of Hα, Hβ and Hγ emitted by moving H atoms produced in a canal ray are observed to have an asymmetrical distribution of intensity which varies in dependence on the experimental conditions. Thus the degree of asymmetry depends on whether the emission of the atoms is of the pressure or the decay type, whether the canal ray and electric field are in the same or opposite directions and on the direction of observation of the emission relative to the field. Variation in the ratio of the polarisation of parallel and perpendicular field components of Hα depending on the direction of observation and the type of excitation is also observed; the polarising effect of the field is found to be smaller for stationary than for moving H atoms. An explanation of all the observed results is given on the bases of Stark's conception of a ring structure for the electron and a consequent axial adjustment of a H atom in an electric field. J. E. K.

3736. Light Emission and Ionisation of States of Motion of the Hydrogen Atom in Strong Electric Fields. J. Stark and R. Ritschl. *Phys. Zeits.* 39. *pp.* 517–522, *July* 1, 1938. *From the Reichsanstalt.*—Attention is drawn to a spectrogram of the lines Hβ to Hε in a strong electric field published in 1930 by v. Trauenberg, Gebauer and Lewin, which was reproduced by Sommerfeld in his book, "Atomic Structure and Spectral Lines," and described as a lo Surdo photograph showing that the Stark components of the Balmer lines cease to exist above certain field strengths which diminish as the series is ascended; later the spectrogram was stated by Lanczos to support his wave-mechanical deduction that the states of motion of H atoms in an electric field become unstable above certain limits and cease to exist. The authors produce evidence to show that the spectrogram in question was not a lo Surdo photograph but a canal-ray photograph taken in a transverse field behind the kathode. Such canal-ray photographs are taken by the authors for Hγ and Hδ in fields up to 470 kV/cm.; noteworthy changes of intensity of the Stark components with increasing field strengths are observed and find a rational explanation on the basis of Stark's conception of a H atom which in its permissible states of motion assumes definite axial orientations with respect to an electric field. J. E. K.

3737. Raman Spectrum Identification of a Mercuric Chlorobromide. M. L. Delwaulle. *Comptes Rendus,* 206. *pp.* 1965–1967, *June* 27, 1938.—The Raman spectrum of a solution of $HgCl_2$ and $HgBr_2$ is not a simple superposition of the spectra of the solutions of the separate salts. In addition to a line at 320 cm^{-1}. due to $HgCl_2$, and to one at 205 cm^{-1}. due to $HgBr_2$, there are other lines at 232 (strong), 347 (medium) and 139 cm^{-1}. (faint). Similar results were got (*a*) by evaporating alcoholic solutions of the mixed salts, and then using the crystals so obtained, for Raman scattering, and (*b*) by fusing the solid salts together in equimolecular proportions. A simple calculation shows that two of the frequencies of vibration to be attributed to $Cl \cdot Hg \cdot Br$ should be approximately 242 and 352 cm^{-1}., in good agreement with the observed values. A. C. M.

3738. Raman Spectrum of BF_3, D. M. Yost, D. DeVault, T. F. Anderson and E. N. Lassettre. *J. Chem. Phys.* 6. *pp.* 424–425, *Aug.*, 1938.—The Raman spectrum of BF_3 was photographed using a purified preparation obtained from the thermal decomposition of $C_6H_5N_2BF_4$. Of the lines observed, that with the frequency 888 cm^{-1}. is certainly, and the band at 439–513 cm^{-1}. is probably due to BF_3. The Raman frequencies and the infra-red results of Bailey *et al*. are assigned to the fundamental modes of vibrations. AUTHORS.

3739. Raman Spectra of H_2S and D_2S (Gas, Liquid and Solid). G. M. Murphy and J. E. Vance. *J. Chem. Phys.* 6. *pp.* 426–429, *Aug.*, 1938.—Raman spectra have been obtained for H_2S and D_2S as gas, liquid and solid. Only one frequency has been obtained in the gas and liquid although three are permitted by the selection principles. In the solids, a single line and a close doublet have been obtained. With the available data it is not possible to make quantitative calculations of isotope effect, force constants, angle or anharmonic factors. AUTHORS.

***3740. Photoelectric Spectrophotometers. R. H. Sewig.** *A.T.M. No.* 83. *J*385–1, *May,* 1938.—Various types of commercially available spectrophotometers are described under the headings: s.p. using colour filters, s.p. using monochromator, self-registering s.p. Sources of error in the different methods are considered. W. S. S.

***3741. Raman Effect Apparatus. A. H. Pfund.** *J.O.S.A.* 28. *pp.* 264–265, *July,* 1938.—A relatively inexpensive yet very efficient piece of apparatus for the routine study of the Raman effect is described. Two automobile headlight reflectors are used facing one another, the mercury lamp occupying the position of the headlight bulb in the one whilst the Raman tube occupies the same position in the other reflector. The radiation is taken to the spectrograph by a right angled prism attached to the end of the Raman tube which is outside the reflector. A. H.

***3742. Two-Prism Spectrograph for Studying U.V. Sources of Radiation and Photographic Emulsions. P. Gesteau.** *Comptes*

Rendus, 206. *pp*. 1630–1631, *May* 30, 1938.—An apparatus consisting of a two-prism spectrograph, fitted with a synchronous motor which rotates simultaneously the photographic plate and a polariser, is described and its use indicated. W. R. A.

***3743. Wire-Grating Spectrometer for Far Infra-Red. P. Barchewitz and M. Parodi.** *Comptes Rendus*, 206. *pp*. 1891–1893, *June* 20, 1938.—The grating used consists of 200 wires of Cu, 0·25 mm. in dia., spaced 0·25 mm. apart; gilded mirrors are used to collimate and focus the beam; and a radiomicrometer is used for measuring the radiation. The first-order spectrum is used, and screens of powdered quartz on paraffin plates 1 mm. thick, and paraffin alone, are used to filter out the unwanted orders of the near infra-red. The instrument is intended for the region 20–100 μ. Wave-lengths are measured to a precision of 1 μ; slit-widths correspond to a wave-band of 2 μ; and the radiomicrometer deflections allow an accuracy of 5% in absorption measurements to be obtained, using an Auer burner as source. D. H. F.

***3744. Comparator for Projection of Spectra on a Screen. A. Gatterer.** *Zeits. f. Instrumentenk*. 58. *pp*. 271–276, *July*, 1938.—The author has developed an apparatus which compares and measures two spectra on the same screen. The light from two lamps passes through two lens systems and the photographic plates to be compared on two plane mirrors which reflect the light on to the screen. By turning the mirrors, the images of the spectra can be brought into contact with each other on the screen. Two magnifications which can be varied to a certain extent, are available which allow two spectra of different dispersion to be compared. A small transparent glass plate which is provided with a millimeter-scale and a vernier, can be laid over the screen for the actual measurement of the spectra. The screen can be replaced by a photographic camera for taking photographs of the magnified spectra. L. K.

See also Abstracts 3590, 3760, 3800.

TRANSMISSION.

***3745. Spectral-Transmissive Properties and Use of Coloured Eye-Protective Glasses. W. W. Coblentz and R. Stair.** *Bureau of Standards, Circ. No. C*421. [28 *pp*], 1938.—In response to the continuing demand for information on coloured glasses for protecting the eyes from glare and from injurious amounts of u.v. and infra-red radiation, this circular gives the spectral-transmissive characteristics of various coloured lenses that are marketed under a variety of trade names, such as Amethyst, Avitint, Azurlite, Bluelite, Calobar, Cerulite, Cruxite, Diantho-Lite, Kalichrome, Noviol, Noviweld, Polaroid, Roselite, Soft-Lite, Solarex, Viopake, etc. For convenience in exposition of the data, the various tinted lenses are grouped under the colour that predominates in transmission—amber, green, blue, etc. Introductory to the presentation of the data, various important incidental questions are discussed, including elimination of glare, distortion of colours, confusion of traffic signals, the hazard in wearing coloured glasses when driving at night, the importance of having standard shades, etc. AUTHORS.

3746. Equivalent Luminous Intensity of Rotating Beacons. G. K. Neeland, M. K. Laufer and W. R. Schaub. *J.O.S.A.* 28. *pp*. 280–285, *Aug*., 1938.—This paper describes a method of measuring the apparent change in the intensity of a beacon as its rate of rotation is altered. The equivalent intensity of several beacons is plotted against the duration of the flash. It is found that Blondel and Rey's law for abrupt flashes also seems to describe the equivalent intensity of service beacons to a first degree of approximation. AUTHORS.

3747. Flashing Character of Aerodrome Floodlight Beacons. W. M. Hampton and J. G. Holmes. *Phys. Soc., Proc.* **50.** *pp.* **642–654,** *Sept.* **1, 1938.**—A simple mathematical method is developed for calculating the frequency of the flash, and the distribution of intensity during the flash, when a floodlight is tilted and rotated so as to form a flashing beacon. The results of a number of typical calculations are given as diagrams and these may be used to estimate the results given by other distributions and conditions which would not be so readily calculated. Comparison is drawn between the various methods of tilting and the ideal requirements of an airway beacon. AUTHOR.

See also Abstract **3541.**

VISION.

3748. Effect of Adaptation on Differential Brightness Discrimination. K. J. W. Craik. *J. Physiol.* **92.** *pp.* **406–421,** *May* **14, 1938.**—The sensitivity of the eye to differences in brightness has been investigated after adaptation to a wide range of intensities greater, equal to, and less than, those at which it was tested. The apparatus provided an adapting field of 45° and a brightness range of 1/2500th to 4000 equiv. f.c. Test fields of $1\frac{1}{2}$° and 36° were also obtainable over the same range of illuminations. The differential threshold is, in general, found to be lowest, approximately 1%, when the "test" and "adapt" illuminations are equal. It is raised very considerably by adaptation to illuminations greatly exceeding the test intensity. Adaptation to illuminations far below the test intensity has a similar, though less marked effect, which is greater when using a large test field than with a small centrally fixated one. A tentative interpretation of the results is given. W. D. W.

3749. Brightness Discrimination and Duration of Increment. C. H. Graham and E. H. Kemp. *J. Gen. Physiol.* **21.** *pp.* **635–650,** *May* **20, 1938.**—The brightness discrimination has been measured for various durations of the increment of intensity, ΔI, from 0·002 to 0·5 sec. $\Delta I/I$ values at constant intensity are highest for the shortest duration and decrease with an increase in duration up to the limits of a critical exposure time. At durations longer than the critical duration, the ratio $\Delta I/I$ remains constant. The Bunsen-Roscoe law holds for the photolysis due to ΔI. This is shown by the fact that, within the limits of a critical duration, the product of ΔI and exposure time is constant for any value of prevailing intensity, I. The critical duration is a function of intensity. As intensity increases the critical duration decreases. W. D. W.

3750. Impulses in the Optic Nerve of Pecten. H. K. Hartline. *J. Cell. and Comp. Physiol.* **11.** *pp.* **465–478,** *June* **20, 1938.**—The retina of the scallop, *Pecten irradians*, possesses two layers of visual cells. Fibres from the proximal layer show a discharge of impulses during illumination of the eye, with properties characteristic of simple visual end organs. Fibres from the distal layer respond only to cessation of illumination, or a reduction in its intensity. These " off " responses are similar in all respects to the discharges of impulses in the " off " response fibres of the vertebrate retina. If the distal cells in the Pecten retina are primary sense cells independent of the proximal layer, these experiments establish the existence of a new kind of sensory cell, capable of being excited only by the removal of a stimulating agent. Alternatively, the distal cells may be ganglion cells, depending on the proximal cells as the source of their excitation, although this is contrary to anatomical opinion. W. D. W.

3751. Influence of Acoustic Stimuli Upon the Limits of Visual Fields for Different Colours. P. A. Yakovlev. *J.O.S.A.* 28. *pp.* 286–289, *Aug.*, 1938.—The acoustic excitations may influence the limits of visual fields for colour stimuli. The limits of the visual fields for the green and blue colours expand under the influence of acoustic stimuli; for the orange-red colour, they contract; for the extreme red colour they do not change at all. The colour sensibility of the peripheral part of retina changes under the influence of acoustic stimuli very much like the change of the colour sensibility of the macular regions of the retina. AUTHOR.

3752. Anomalous Trichromatism and its Relation to Normal Trichromatism. J. H. Nelson. *Phys. Soc., Proc.* 50. *pp.* 661–702, *Sept.* 1, 1938.—The characteristics of six deuteranomalous observers and one protanomalous observer have been examined. In the case of the former it has been shown that, in contrast with what occurs in normal trichromatism and dichromatism, it is not possible to take mean values as representative of the deuteranomalous observer. This fact combined with the results of the statistical survey with the Nagel anomaloscope, suggests that anomalous trichromatism is an intermediate state between dichromatism and normal trichromatism. In the case of the protanomalous this transition would seem to be of a continuous nature, but for the deuteranomalous there is a subsidiary maximum in the distribution curve. AUTHOR.

3753. Colour Sensations Produced by U.V. Light. A. G. Gaydon. *Phys. Soc., Proc.* 50. *pp.* 714–719; *Disc.*, 719–720, *Sept.* 1, 1938.—The crystalline lens of the author's left eye has, as the result of an accident, been destroyed. The eye is now sensitive to u.v. light of quite low intensity. The sensation between 3600 and 3100 Å is blue, not violet. The sensations produced by extremely faint u.v. light on the dark-adapted retina are discussed; the behaviour is essentially similar to that in normal scotopic vision, the light appearing colourless and the peripheral region being more sensitive than the fovea. AUTHOR.

3754. Absorption Spectrum of Visual Purple. A. M. Chase and C. Haig. *J. Gen. Physiol.* 21. *pp.* 411–430, *March* 20, 1938.—The absorption spectra of visual purple solutions extracted by various methods have been measured with a sensitive photoelectric spectrophotometer and compared with the classical visual purple absorption spectrum. Hardening the retinas in alum before extraction yielded visual purple solutions of much higher light transmission in the blue and violet, and investigations of the colour at various pH values showed that, over the pH range from 5·5 to 10·0, the visual purple colour purity was greatest at the low pH. The colour purity was also greater the higher the temperature, up to 40° C. In no case was the symmetry of the unbleached visual purple absorption spectrum improved sufficiently for it to resemble the classical curve. It is suggested that the classical curve is that of the light sensitive group only, whereas the absorption curve obtained in the present work represents the molecule as a whole. W. D. W.

See also Abstracts 3745 and
2763B. Visibility of Reading Tasks. L. H. Brown, L. G. Gianini and T. A. Robinson.

X-RAYS.

3755. L-Series of Ag. L. G. Parratt. *Phys. Rev.* 54. *pp.* 99–114, *July* 15, 1938.—With a new two-crystal vacuum spectrometer a systematic and precise study of 36 L-series emission lines of Ag has been made which includes measurements of wave-lengths, relative intensities, line widths and indices of asymmetry. These lines include 21 satellite lines. The contours of the three L absorption edges of silver were also recorded. From these data have been determined the widths of all the energy levels for single ionisation of silver. From the widths of satellite lines are discussed the widths of certain states of double ionisation. AUTHOR.

3756. Measurement of Supervoltage X-Rays With the Free-Air Ionisation Chamber. L. S. Taylor, G. Singer, and A. L. Charlton. *Bureau of Standards, J. of Research,* 21. *pp.* 19–44, *July,* 1938.—A free-air ionisation chamber for the measurement of supervoltage X-rays is described. It is built on the guarded-field principle and of such size as to permit measurements for X-ray excitation voltages from 150 to 350 kV at atmospheric pressure and 200 kV upward at elevated pressures. The electrode system is contained in a pressure cylinder of such size as to give an equivalent plate spacing of 4 m. at a pressure of 10 atm. The chamber characteristics have been studied in the range of 200 to 400 kV. The most important finding is the required increase in plate separation at the higher voltages. While reasonable, this is at variance with the findings of other workers. From the measurement of the plate separation for full electronic equilibrium, electron ranges may be obtained. To carry out these measurements it was necessary to design and construct a h.v. plant capable of extreme steadiness of operation. This was accomplished with a four-stage rectifier having valves operated on a single pumping system. Potentials were carefully distributed through the system with the result that the voltage could be measured and controlled within ±¼%, which also represents the variation in tube output. The X-ray tube is of the simple 4-stage type, made up of pyrex cylinders. By means of an insulated target, only the target current is measured. AUTHORS.

3757. X-Ray Investigation of the Form of Acetylsalicylic Acid in Certain Sugars. S. S. Sidhu. *J. of Applied Physics,* 9. *pp.* 546–550, *Aug.,* 1938.—X-ray studies of samples made of sucrose, glucose, and acetylsalicylic acid were made to determine if the latter is in solid solution with the sugars. The main constituent of the samples was sucrose and the amounts of acetylsalicylic acid varied from 1·5 to 20%. The samples were prepared by melting and heating the sugar combinations to 160° C., removing essentially all the water and allowing to cool. The acetylsalicylic acid was then incorporated in one set of samples at 140° C. and in another at a temperature between 110–115° C., that is, both above and below the melting point (133–5° C.) of the compound. The former samples were far more hygroscopic than the latter, but in neither case did the acetylsalicylic acid seem to form a solid solution with the rest of the constituents. AUTHOR.

See also Abstracts 3459, 3594, 3669 and
2695B. X-Ray Stereometer. C. D. Moriarty.

HEAT.

CALORIMETRY.

See Abstracts 3774, 3789.

CONDUCTION.

3758. Flux Distribution of Heat Generated Between Two Media in Poor Contact. P. Vernotte. *Comptes Rendus*, 207. *pp.* 124–126, *July* 11, 1938.—Heat generated between two media has been shown to commence to flow into these media proportionally to $\sqrt{kc\rho}$ (where k, c and ρ are the thermal conductivity, specific heat and density) when the media are in good thermal contact [see Abstract 2927 (1938)]. Equations are now derived in which allowance is made for surface resistances which hinder the heat flow. Attention is directed to a paradox in that the initial heat distribution seems to depend on the boundary conditions, a result which is explained as resting on an obscure property of the equations rather than on physical facts. R. W. P.

3759. Thermal Conductivity of Metals. R. E. B. Makinson. *Cambridge Phil. Soc., Proc.* 34. *pp.* 474–497, *July*, 1938.—The methods used to measure separately the electronic and lattice heat conductivities, κ_e and κ_g in a metal are reviewed, and it is pointed out that care is necessary in interpreting the results in view of the underlying assumptions. The equations given by Wilson for κ_e and for the electrical conductivity σ are used to plot the theoretical values of the electronic Lorentz ratio $L_e=\kappa_e/\sigma T$ as a function of T, both for the monovalent metals and for a model metal with $1\cdot8\times10^{-2}$ conduction electrons per atom, which is taken to represent Bi sufficiently accurately for this purpose. Curves for κ_e and κ_g as functions of T are given in both cases, and these, together with a comparison of the observed Lorentz ratio and L_e show that in the monovalent metals κ_g is unimportant at any temperature, but in Bi it plays a major part at low temperatures, in agreement with experimental conclusions. Quantitatively the agreement is good for Cu and, as far as the calculations go, reasonable for Bi. Scattering of lattice waves at the boundaries of single crystals (including insulators) at temperatures of a few degrees absolute is shown to be consistent with the experiments of de Haas and Biermasz on KCl and to be responsible for the rise in thermal resistance in this region as suggested by Peierls. The assumption in the theory of electronic heat conduction that the lattice energy distribution function has its thermal equilibrium value is examined in an appendix. The conclusion is that it should be satisfactory though the proof of this given by Bethe is seen to be inadequate. AUTHOR.

3760. Energy Exchanges at Boundary Surfaces. H. J. de Boer. *Zeits. f. Elektrochem.* 44. *pp.* 488–497, *Aug.*, 1938.—This subject is reviewed under 9 headings, *viz.*: (1) Heat exchanges between gas molecules and solid walls, with a discussion of the accommodation coefficient. (2) Exchange of potential energy into heat. (3) Activated adsorption. This section considers the adsorption of H_2 and O_2 at metallic surfaces. (4) Surface reactions. (5) Depression of the work of ionisation by adsorbed atoms. (6) Surface migration. (7) Light absorption in the adsorbed state; here as examples are studied the absorption spectra of Rhodamin B in aqueous solution and at a CaF_2 surface. The section also contains an investigation of active spots with respect to van der Waals adsorption, and the adsorption of dipole molecules (OH-dipoles), the examples studied being iodine, CsH, para nitrophenol and alizarin adsorbed at CaF_2 surfaces. (8) Optical sensitisers. (9) Changes in the structure of a surface, *e.g.*, swelling by adsorption and recrystallisation. The paper is illustrated by 15 diagrams. H. H. Ho.

3761. Heat Conduction in a Medium Having Thermal Properties Depending on the Temperature. M. R. Hopkins. *Phys. Soc., Proc.* 50. *pp.* 703–706, *Sept.* 1, 1938.—Typical standard calculations in the theory of heat conduction are modified to allow for the variation of the thermal properties of the medium with temperature. AUTHOR.

3762. Dependence on Thickness of the Thermal Resistance of Crystals at Low Temperatures. W. J. de Haas and T. Biermasz. *K. Onnes Lab., Leiden, Comm. No.* 253*b. Physica,* 5. *pp.* 619–624, *July,* 1938. *In English.*—In continuation of previous work [see Abstracts 760 and 2071 (1938)], values are tabulated for the thermal resistance of four silica rods (perpendicular to the principal axis) of 0·216, 0·359, 0·454 and 0·775 cm. dia. at 1·67–89·4° K. The resistance (w) is not inversely proportional to the diameter (d); for a sufficiently large value of d (3–4 cm.) saturation would be attained. The saturation limit for KCl is attained at a thickness of about 1 cm.; the smaller value in this case is possibly attributable to the smaller dimensions of the mosaic crystals in KCl. It is possible that the reflection coefficients of the mosaic crystals of KCl and SiO_2 for elastic waves are different. The phenomena are explainable in terms of the hypothesis of reflection of elastic waves by the walls of the rods and the mosaic crystals. J. S. G. T.

3763. Pressure Coefficient of Thermal Conductivity of Metals. C. Starr. *Phys. Rev.* 54. *pp.* 210–216, *Aug.* 1, 1938.—The pressure coefficients of thermal conductivity of Cu, Ag and Au were determined by means of an improved longitudinal heat flow method. The results indicate that the ratio of the thermal to the electrical conductivity (the Wiedemann-Franz ratio) for these metals, over a pressure range of 12,000 kg./cm^2., has a small positive coefficient of approximately 1% in 10,000 kg/cm^2. These results are at variance with those of Bridgman who used a similar method but found that the pressure coefficient of the Wiedemann-Franz ratio may be either negative or positive and is more often negative. Experiments are reported which prove that the negative coefficients found by Bridgman were due to a systematic convection error undiscovered in his longitudinal heat flow method. It is reasonable to suppose that the positive pressure coefficient of the Wiedemann-Franz ratio is due to the non-electronic part of the thermal conductivity, and this assumption is further supported by the correlation between these positive coefficients and the volume compressibilities of the metals. AUTHOR.

CONVECTION.

3764. Non-Stationary Free Convection. D. A. Frank-Kameneckij. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 7. *pp.* 409–412, 1938. *In English.*—Dimensional analysis is applied to the thermal and hydrodynamical equations which represent free convection in the initial non-stationary stage. It is shown that the temperature distribution and the coefficient of heat transfer can be expressed as functions of two non-dimensional terms t/τ_1 and t/τ_2. The values of τ_1 and τ_2 are d^2/κ and $(d/g\beta\theta_0)^{\frac{1}{2}}$ respectively, where d=length parameter, κ=thermal diffusivity, g=gravitation acceleration, β=coefficient of expansion and θ_0=characteristic temperature difference. Since $(\tau_1/\tau_2)^2$= GrPr^2, it follows that the functions can be so transformed that only Gr and one of the arbitrarily chosen quantities τ_1 or τ_2 remains. The limiting case of $\tau_1 \gg \tau_2$, *i.e.*, Gr $\gg$ 1 has already been discussed by the author [see Abstract 761 (1938) and following Abstract.] R. W. P.

3765. Temperature Distribution in Reaction Vessel and Stationary Theory of Thermal Explosions. D. A. Frank-Kameneckij. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 7. *pp.* 413–414, 1938. *In English.*—By a further application of dimensional analysis to similar equations [see preceding Abstract] relations among non-dimensional parameters are established which enable the critical condition for inflammation to be determined in terms of one parameter δ. This parameter assumes a critical value for each vessel. For low gas pressures and small vessels Gr→*o*, and convection becomes negligible. Critical values of δ are calculated for this case for spherical, cylindrical and plane parallel vessels, and these are found to be in satisfactory agreement with experimental determinations. R. W. P.

FUSION AND SOLIDIFICATION.

3766. Melting Points of Paraffins and Fatty Acids. E. B. Moullin. *Cambridge Phil. Soc., Proc.* 34. *pp.* 459–464, *July*, 1938.—The plot of the melting points of paraffins against the number of C atoms is a smooth curve. Curves for fatty acids are similar but members containing an odd number of C atoms lie on one curve ("odd curve"), whilst those containing an even number lie on another ("even curve"). The paraffin curve and acid curves can be superposed under the following conditions; the ordinate scales (melting points) are multiplied by 2 and the curves are displaced bodily by +15° for the "odd curve" and by +6° for the "even curve." This is explained by the fact that, as X-ray examination of crystals of fatty acids has shown, the carboxyl groups are contiguous and that double molecules are formed. Relationships between melting points and chain lengths are discussed. W. R. A.

***3767. Freezing Point of Methanol; Simple Cryostat. E. E. Roper.** *Am. Chem. Soc., J.* 60. *pp.* 1693–1695, *July*, 1938.—A simple cryostat is described which is applicable to the determination of freezing points below 0° and data are appended describing the operation of the cryostat during the freezing point determination of a methyl alcohol sample. The freezing point of a particularly pure sample of methanol prepared by Jones and Fornwalt was determined to be $-97{\cdot}68 \pm 0{\cdot}02°$. A short discussion is given of the freezing point–density relationship. AUTHOR.

See also Abstract 3783.

TEMPERATURE.

3768. Wall Temperature and Dwelling Comfort. H. Roose. *Gesund. Ing.* 61. 24. *pp.* 325–329, *June* 11, 1938.—About half the heat loss of the human body is due to radiation, the individual synthesises the effects of wall and air temperatures into a general sensation expressed by ($0{\cdot}45\,\theta$ wall $+0{\cdot}55\,\theta$ air). The author describes a new method of measuring wall temperature—two balls, one nickel plated and burnished (4%) and one black painted (96·5%) are suspended a yard above the floor and maintained electrically at 36·5° C.; from the difference between the currents required the wall temperature may be calculated. Tests on 14 rooms show that a 25 cm. wooden wall is equivalent to a masonry wall 80 cm. thick, with or without wood facing. The temperature of masonry walls is 0·5–1° lower, and with walls of hollow concrete block with cork insulation about 1–2° C. lower than for the wooden walls. D. R. H.

***3769. Electrolytic Resistors for D.C. Applications in Measuring Temperatures. D. N. Craig.** *Bureau of Standards, J. of Research,* 21. *pp.* 225–233, *Aug.*, 1938.—An improved electrolytic resistor, developed primarily for temperature indicators on radio meteorographs, is described. On such instruments variable unidirectional currents are employed. Resistors to be used successfully in such applications require (1) large temperature coefficient, (2) low freezing point, (3) light weight, (4) reversibility, (5) stability of calibration, (6) hermetical sealing, (7) high resistance with minimum inductance and capacitance, and (8) rapid response to temperature changes. The resistor consists of Cu electrodes in a capillary tube filled with a solution of Cu_2Cl_2, HCl and EtOH. Various proportions may be used in obtaining solutions which will freeze at –75° C. The alcohol affords a convenient means of adjusting the resistance of a particular resistor to the desired value. Within reasonable limits of impressed voltage, the resistors have been found reliable over a temperature range of +30° to –75° C. They respond satisfactorily to changes in temperature and hold their calibration for periods of time much in excess of that required for a flight. Ratios of the resistances R_t/R_0 measured with d.c. agree with those measured with a.c. Temperature indications are believed to be accurate within 1° C. even at the lowest temperature. AUTHOR.

***3770. Sensitive Method of Temperature and Pressure Measurement. S. Zamenhof.** *Acta Physica Polonica,* 7. 1. *pp.* 1–4, 1938. *In English.*—The method is based on inserting a thin resistance wire into the capillary tube of a mercury thermometer, so that the rising thread short-circuits the wire and reduces its resistance. The possibility of applying a similar method to pressure measurements is also mentioned. AUTHOR.

3771. Production and Measurement of Low Temperatures. K. R. Dixit. *Current Science,* 12. *pp.* 589–599, *June,* 1938.—The production and measurement of low temperatures, attainable by the liquefaction and solidification of gases, over the period 1823 to the present day, are interestingly reviewed. Temperatures lower than 0·71° K. are attainable by the method of adiabatic demagnetisation of paramagnetic salts. The lowest temperature hitherto attained is 0·0044° K., reached by the adiabatic demagnetisation of a mixture of chrome- and potash-alum. The possibility of attaining still lower temperatures by utilising the relatively short time (about 1 sec.) for exchange of energy between the nuclear spins and conduction electrons of metals is suggested. J. S. G. T.

See also Abstracts 3762, 3767, 3854, 3855, 3878.

THERMOCHEMISTRY.

3772. Heat of Solution of Anhydrous $AlCl_3$. W. A. Roth and E. Börger. *Zeits. f. Elektrochem.* 44. *p.* 540, *Aug.*, 1938.—Preparative details are first given of the samples of aluminium chloride employed and are succeeded by a brief description of the experimental procedure followed. The data obtained fluctuated somewhat, but from N = 4000 to N = 9500, the value of the heat of solution was found to be + 79·45 ± 0·1 kg.cal.

This value is higher than the data of previous authors, but this is ascribed to the greater purity of the $AlCl_3$ used. H. H. Ho.

3773. Heats of Solution of Calcium and Magnesium Oxides and Hydroxides. K. Taylor and L. S. Wells. *Bureau of Standards, J. of Research,* 21. *pp.* 133–149, *Aug.,* 1938.

3774. Atomic Heat of Nitrogen in Nitrides. Part I. S. Satoh. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 799. *pp.* 751–760, *July,* 1938. *In English.*—The atomic heats of N are deduced from the molecular heats of various nitrides for the purpose of applying Neumann-Kopp's law. They were found to have the value of about 2·4 in nitrides of elements with small atomic numbers and about 4 in nitrides of elements with large atomic numbers. As a whole, the values were 2 ~ 5, considerably removed from the value 6·2. The variation of the atomic heats with temperature is also discussed. AUTHOR.

3775. Detonation in Explosives by Thermal Impulse. A. F. Belajev. *Comples Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 4–5. *pp.* 267–269, 1938. *In English.*—It is often necessary in practice to deal with the action of some form of thermal impulse in an explosive, and the present investigation attempts to establish the general laws of thermal initiation in the case when the thermal impulse is concentrated in a volume of the order of a few cubic microns in a very short interval of time (10^{-3}–10^{-4} sec.). Pt wires, of 2 and 5μ dia. and 3 mm. long situated in the explosive, were used as the source of the thermal impulse. It was established that while in the case of volatile explosives the chemical factors were of primary importance in the process of the development of detonation, a considerable part is played by evaporation which, under favourable conditions, may change the whole character of the chemical process and in particular retard the development of detonation and cause the slow combustion to take place from beginning to end in the gas phase. H. H. Ho.

3776. Two-Stage Spontaneous Ignition of Hydrocarbons. A. V. Belov and M. B. Neumann. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 6. *pp.* 333–336, 1938. *In English.*—Pentane-air mixtures are admitted to a hot steel bomb and the pressure changes are recorded photographically. It is found that the region of 2-stage spontaneous ignition is limited not only with respect to temperature but also with respect to pressure. L. A. W.

See also Abstracts 3524, 3765, 3798.

THERMODYNAMICS.

3777. Complete Diagram of State of Binary Systems with Vapour Pressure Maxima. E. Jänecke. *Zeits. f. phys. Chem.* 182. *Abt.A.* 3. *pp.* 177–185, 1938.—The equilibrium of binary systems which show a vapour pressure maximum in the presence of the solid state has been investigated. The equilibria when there is formation of a simple eutectic, and of a continuous mixed crystal phase between the two solid phases are particularly considered. A. J. M.

3778. Diagrams of State for Moist Gases. A. Stradelli. *Ricerche di Ingegneria,* 6. *pp.* 36–42, *March–April,* 1938.—Examples are given of the method of tracing and using a diagram of state for gaseous mixtures containing a condensible component, in particular for moist air. The method permits the following in detail of transformations with considerable variations of pressure, and of taking account of existing solid and liquid phases. J. J. S.

3779. Relativistic Study of the Joule-Thomson Effect and Adiabatic Processes in a Gas. Part II. D. V. Gogate. *Phil. Mag.* 26. *pp.* 166–173, *July*, 1938.—The Joule-Thomson effect and adiabatic processes in a relativistic non-degenerate gas obeying Fermi-Dirac statistics have been considered in a previous paper [see Abstract 2511 (1938)]. These considerations are now extended for a degenerate gas, *i.e.*, degenerate in the sense of the Fermi-Dirac statistics. Expressions are derived to explain these effects, and the results for the limiting states of a Fermi-Dirac gas, with and without the use of relativity mechanics, are compared. C. J. B. C.

3780. Density of Energy States in Solids. S. H. Bauer. *J. Chem. Phys.* 6. *pp.* 403–404, *July*, 1938.—A treatment of the problem using thermodynamic functions of the aggregate which yield equations, the solutions of which are experimentally indistinguishable from those specified by the data. G. C. E.

3781. Solid-Liquid Equilibrium in Argon. O. K. Rice. *J. Chem. Phys.* 6. *pp.* 472–475, *Aug.*, 1938.—The method of investigating the equilibrium between solid and liquid phases, outlined in a previous paper [see Abstract 3185 (1937)] has been applied to argon. (In this method the intersections of the curves for the thermodynamic quantities $T(\partial S/\partial V)_T$ and $(\partial E/\partial V)_T + P$, plotted as functions of the volume, are used to determine the conditions of equilibrium of the system.) Curves are found for the functions $(\partial S/\partial V)_T$ and $(\partial E/\partial V)_T$ assumed dependent on volume and independent of temperature, which can reproduce with reasonable accuracy most of the melting parameters of argon at high pressures. The significance of these curves is discussed. AUTHOR.

3782. Thermodynamic Properties of Propane. J. D. Kemp and C. J. Egan. *Am. Chem. Soc., J.* 60. *pp.* 1521–1525, *July* 6, 1938.—The heat capacity of condensed propane was measured from 15° K. to the boiling point. The melting point was found to be 85·45 ± 0·05° K., the boiling point 231·04 ± 0·05° K., the heat of fusion 842·2 ± 0·8 and the heat of vaporisation 4487 ± 4 cal./mole. Vapour pressure measurements were made on liquid propane and the results represented by the equation (liquid propane, 166 to 231° K. (0° C. = 273·10° K.)) $\log_{10} P_{(\text{Int. cm. Hg})} = -(1325{\cdot}358/T) + 9{\cdot}64920 - 0{\cdot}0118950T + 0{\cdot}000013420T^2$. The density of propane gas at 298·10° K. and 1 atm. was found to be 1·8325 ± 0·0007 gm./l. At 1 atm. at the boiling point the experimental entropy of propane (ideal gas) was evaluated as 60·45 ± 0·10 cal./deg. per mole. The entropy of propane calculated with the assumption of free internal rotation minus the experimental entropy, $S_{\text{free}} - S_{\text{exp.}}$ (at the boiling point), was found to be 3·40 ± 0·3 cal./deg. per mole, which corresponds to a potential barrier of 3300 ± 400 cal./mole hindering the internal rotation of the methyl groups. The entropy of propane (ideal gas, with a 3300 cal./mole barrier) at 1 atm. and 298·10° K., was found to be 64·7 ± 0·3 cal./deg. per mole (nuclear spin entropy not included). This is the entropy value to be used in thermodynamic calculations. AUTHORS.

3783. Communal Entropy and the Theory of Fusion. O. K. Rice. *J. Chem. Phys.* 6. *pp.* 476–479, *Aug.*, 1938.—The concept of "communal" entropy, introduced by Hirschfelder, Stevenson and Eyring, is further discussed in this paper. It appears from both theoretical and empirical considerations that the entropy of fusion of simple solids is *not* primarily concerned with the excitation of communal entropy. A discussion is given of the nature of communal entropy and its manner of excitation. [See Abstract 5394 (1937).] Author.

3784. Entropy of Ethyl Alcohol from Molecular Data and Equilibrium in Hydration of Ethylene. S. C. Schumann and J. G. Aston. *J. Chem. Phys.* 6. *pp.* 480–484, *Aug.*, 1938.—The entropy and free energy of ethyl alcohol gas have been calculated from the molecular data at several temperatures on the basis of (*a*) free internal rotation, (*b*) restricted rotation (with potentials; about C – C bond = 3000, C – O bond = 10,000 cal.). The latter values are in perfect agreement with those from the third law and from the equilibrium data on the hydration of ethylene. Authors.

3785. Entropy of Acetone and Isopropyl Alcohol from Molecular Data. Equilibrium in Dehydrogenation of Isopropyl Alcohol. S. C. Schumann and J. G. Aston. *J. Chem. Phys.* 6. *pp.* 485–488, *Aug.*, 1938.—The entropy and free energy of acetone and isopropyl alcohol gases have been calculated from the molecular data at several temperatures on the basis of (*a*) free internal rotation, (*b*) restricted rotation (with the potentials: Acetone, about C – C bond = 1000 cal.; isopropyl alcohol, about C – C bond = 3400 cal. about C – O = 5000 cal.). The values based on restricted internal rotation were made to be consistent with the third law values. They are in better agreement with the ΔS values from the equilibrium data than those assuming free rotation. Authors.

3786. Entropy of CO. R. Kalschew. *Zeits. f. phys. Chem.* 40. *Abt.B.* 4. *pp.* 273–280, 1938.—Thermal measurements to determine the entropy of CO do not agree with optical measurements of the same quantity: these latter are about 1·1 Clausius greater than the thermal determinations. Thermal investigations have therefore been made in a special form of vacuum calorimeter designed for determinations at low temperatures. The specific heat was measured through the range from 52° to 75° Abs. No differences were observed when the CO was first cooled down to a temperature below its transformation point —61·49° Abs—, or to a temperature between this point and its melting point —68·10° Abs.—, or not so low as its melting point. The heats of transformation and of fusion were also measured. Possible explanations are offered for the energy difference between the two states of CO at the transition point. These experiments also show the difference of 1·1 Clausius from optical determinations. G. G.

3787. Absolute Rates of Heterogeneous Reactions. Part I. General Theory of Adsorption. G. E. Kimball. *J. Chem. Phys.* 6. *pp.* 447–453, *Aug.*, 1938.—The statistical theory of reaction rates, developed by Eyring for homogeneous reactions, is extended to include heterogeneous reactions. It is shown that rates of adsorption and desorption are governed by the same form of mathematical expression in terms of partition functions of the system as rates of homogeneous reactions, provided only that for the activated state a "super-partition function," formed by adding together the partition functions for all the active spots, is used. The pseudo-thermodynamical form of the rate constant form is discussed, and illustrated by applications to special cases. Author.

See also Abstracts 3553, 3564, 3593, 3788, 3809.

VAPORISATION AND CONDENSATION.

*3788. **Vapour-Liquid Equilibrium. Part I. Apparatus for Study of Systems with Volatile Components. G. Scatchard, C. L. Raymond and H. H. Gilmann. Part II. Chloroform-Ethanol Mixtures at 35°, 45° and 55° C. G. Scatchard and C. L. Raymond.** *Am. Chem. Soc., J.* 60. *pp.* 1275–1287, *June,* 1938.—Part I describes an equilibrium still, embodying a Cottrell pump heated only by the equilibrium vapour, which is designed for studying vapour-liquid equilibria of systems having volatile components. Details are also given of the experimental procedure and subsidiary apparatus used for precision measurements of temperature and pressure. Part II contains experimental results for the vapour and liquid compositions, and the equilibrium pressures for mixtures of chloroform and ethanol at 35°, 45° and 55° C. Deviations from the gas laws are established, and from the results calculations are made of the excess chemical potentials, free energy, heat content and entropy of mixing. Each of the last two passes through a maximum and minimum, and rough experiments show a similar result for the excess heat content of mixing of CCl_4-ethanol systems. The results are explained in terms of dipole-interactions and molecular bonding. R. W. P.

3789. Vapour Pressure of Propane. P. Harteck and R. Edse. *Zeits. f. phys. Chem.* 182. *Abt.A.* 3. *pp.* 220–224, 1938.—The vapour pressure of propane contained in a Stock's vapour pressure thermometer is determined over the temperature range −110° to −41° C. by comparison with similar thermometers containing HCl, CO_2, or NH_3. The results are tabulated at 1° C. intervals, and, assuming propane to behave as a perfect gas, the heats of vaporisation at −48° and −100° C. are calculated as 4704 ± 7 and 5060 ± 10 cal./gm. respectively. The boiling point at normal atmospheric pressure is given as $-41{\cdot}14 \pm 0{\cdot}01°$ C. R. W. P.

3790. Evidence for Validity of Raoult's Law. H. H. Gilmann and P. Gross. *Am. Chem. Soc., J.* 25. *pp.* 1525–1530, *July,* 1938.—The total vapour pressures of the systems benzene–diphenyl, benzene–benzyl benzoate and ethyl acetate–benzyl benzoate have been determined from 50 to 95° over limited ranges of concentration. The bearing of these measurements on the validity of Raoult's law as applied to these systems is discussed. The benzene–diphenyl and benzene–benzyl benzoate systems follow Raoult's law within the limits of the experimental error. The ethyl acetate–benzyl benzoate system shows deviations several times larger than the experimental error, indicating a slight, but real, positive deviation from Raoult's law. AUTHORS.

3791. Activity and Osmotic Coefficients of Trivalent Metal Chlorides. C. M. Mason. *Am. Chem. Soc., J.* 60. *pp.* 1638–1647, *July,* 1938.—The osmotic coefficients of chlorides of Al, Sc, Y, La, Ce, Pr and Nd have been determined in aqueous solution at 25° by the isotonic method of Robinson and Sinclair [see Abstract 4449 (1934)]. The activity coefficients of these salts are computed from the osmotic coefficients. The data obtained are compared with theory. AUTHOR.

See also Abstract 3553.

ACOUSTICS.

3792. Ultrasonic Radiation Field of a Quartz Disc Radiating into Liquid Media. F. E. Fox and G. D. Rock. *Phys. Rev.* 54. *pp.* 223–228, *Aug.* 1, 1938.—The radiation pressure of sound waves on a spherical obstacle is used to determine the distribution of intensity in the sound field of a quartz disc radiating into a liquid medium. The measured distribution of intensity along the axis normal to a crystal face is compared to that to be expected from a plane piston radiating into a semi-infinite medium, and the agreement shows that the theoretical assumptions are fulfilled for the case used and that the " effective area " of the piston is essentially the actual area of the quartz disc. AUTHORS.

3793. Absorption of Supersonic Waves in Electrolytes. P. Bażulin. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 19. 3. *pp.* 153–156, 1938. *In German.*—The absorption coefficient of supersonic waves in aqueous solutions of a number of common salts is measured. The absorption is proportional to the molecular concentration, and approximately proportional to the square of the frequency. The author also concludes that the absorption increases with the molecular weight and with the valency of the kation. K. M. C.

3794. Break in Register in Singing. W. Trendelenburg. *Preuss. Akad. Wiss. Berlin, Ber.* 1. *pp.* 5–23, 1938.—The disturbance of voice sounds in singing, caused by artificially added tubes, noted by D. Weiss in 1932, is further investigated. When a series of notes is sung into a long tube of constant length, disturbances are noted at the fundamental frequency of the system : throat-mouth—cavity-tube, and also at the higher partials. When tubes of variable length are used, into which are sung notes of constant vocal-cord frequency, an extensive parallel is shown to exist with the experiments of Vogel on reed pipes with added tubes [see Abstract 1627 (1920)]. G. E. A.

3795. Standing Wave in Water Column Measured by a Broca-Tube. Y. Nisimura and Y. Kohasi. *Tokyo Univ. Aeronaut. Research Inst. Report, No.* 164. [10 *pp.*], *June,* 1938.—A long steel pipe filled with water was set vertically on a water reservoir, and near the lower end of the pipe a source of sound was immersed so as to produce a purely sinusoidal wave in the pipe. The standing wave was produced in it between the wave radiated from the source and the wave reflected by the free surface at the upper end of the pipe. The axial distribution of intensity in the pipe was measured by a small Broca-tube connected with a Rayleigh disc. The results show that the form of standing wave is quite different according to the height of the water column in the pipe and is much distorted from a sinusoidal wave but the same pattern of wave is repeated every half wave-length. Owing to the elastic yielding of the wall of the pipe, the velocity of sound obtained from the experiment was smaller than that in free water, and was in close agreement with H. G. Green's calculation. The distortion of the wave is due to the existence of a Broca-tube in the sound field. The problem is solved theoretically and good agreement obtained with experiment. AUTHORS.

See also Abstracts 3455, 3751 and

2837B. Reverberation Measurement. A. Bielusici and O. Roman.
2839B. Acoustical Insulation by Double Partitions of Dissimilar Components. J. E. R. Constable.
2841B. Noise Measurement. P. Huber.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

3796. Mutual Shunt Method of Measuring Self Inductance at Radio Frequencies. A. Campbell. *Phys. Soc., Proc.* 50. *pp.* 655–660, *Sept.* 1, 1938.—A simple method of measuring self inductance is described, in which the value is read directly on a mutual inductometer. Its secondary circuit, with an a.c. ammeter in series, is put in parallel with the coil to be tested, the combination being connected, through the primary coil, to an a.c. source of radio frequency giving constant current. The mutual inductance is now varied until the ammeter reads a minimum current, and then the self inductance is equal to the mutual inductance. This result does not involve resistance or frequency. Methods for eliminating the errors due to self and mutual capacitances in the inductometer are indicated. AUTHOR.

See also Abstract 3871.

CONDUCTION AND DISCHARGE IN GASES.

3797. Conductivity and Dielectric Constant of an Electron Stream. H. E. Hollman and A. Thoma. *Ann. d. Physik,* 32. 5. *pp.* 459–464, *July,* 1938.—The authors criticise Benner's equations [see Abstract 1955 (1930)]. From their theory of the inversion of electrons and using Maxwell's equations they deduce expressions for the conductivity and dielectric constant. As the product (frequency × transit time of electrons) increases from zero, the conductivity follows a damped cyclic curve about zero, and the dielectric constant a similar curve about unity. That is, the conductivity may be negative, and the dielectric constant may be less than one. In the regions in which the dielectric constant tends to pass through zero and become negative plasmoidal oscillations are set up, and the theory no longer holds. W. H. W.

3798. Explosion Potential in Benzene. E. Badareu and L. Constantinesco. *Comptes Rendus,* 207. *pp.* 217–220, *July* 18, 1938.—Explosion potentials furnish valuable information concerning the conditions in a gas and at the surface of the kathode at the moment of the lighting-up of the discharge. The potential is expressed as a function of the product of p, the gas pressure, and d, the distance between the electrodes. The moment of the lighting-up of the discharge is determined by watching for a sudden deviation in a galvanometer placed in circuit with the discharge tube. Experiments were made at pressures from 0·1 to 1·8 mm. Hg. and for values of d between 0·1 and 1·2 cm. Paschen's law was found to be followed strictly. From the experimental curve the values $V_{min} = (489 \pm 1)$ volt and $pd_{min} = 0{\cdot}24 \pm 0{\cdot}01)$ mm. Hg. cm. are obtained. These values and also the shape of the curve are compared with those which have been obtained for other gases. G. G.

3799. Rôle of Tube Walls, and Surface and Space Charges in Electrical Discharges through Rarefied Gases. J. Zeleny. *Frank. Inst., J.* 226. *pp.* 35–65, *July,* 1938.—The p.d. between striæ in H_2 are found to be greater in wide than in narrow tubes at pressures above 1·1 mm. The mechanism of the passage of a discharge through a long metal tube with open and gauze-covered ends is discussed and the potential and current distributions are measured. The distribution of the space and surface charges along a glass discharge tube was found to depend markedly on whether the anode or the kathode was connected to earth. G. C. E.

3800. Gas Temperature and Population of Atomic Levels in a Carbon Arc at Low Pressure. R. C. Mason. *Physica,* 5. *pp.* 777–784, *Aug.,* 1938. *In English.*—In a carbon arc in air at pressures from 250 mm. to 10 mm. the intensities of the CN 3883 band and of certain lines of Ba and Zn, added in small amount to the anode, have been measured. From the band, the temperature of the gas was determined while from the lines, with the aid of transition probabilities measured at atmospheric pressure, the relative population of several excited states has been found. With decreasing pressure, the gas temperature did not change much, but the density of excited atoms exceeded the density expected in the thermal equilibrium by increasing amounts. It is probable electrons having energies above those corresponding with the energy distribution at the gas temperature are responsible for the increased excitation. AUTHOR.

3801. Critical Potentials of CO. J. Savard. *Soc. Roumaine de Physique, Bull.* 39. 71. *pp.* 5–10, 1938.—19 critical potentials have been found between 4·75 and 13·2 eV by the electron impact method. The values agree with the minima of the potential curves deduced from spectroscopic data. The results are at variance with the Franck-Condon principle which would exclude many of the experimentally found potentials.
G. C. E.

3802. Slow Positive Rays. A. Rostagni. *N. Cimento,* 15. *pp.* 117–120, *Feb.,* 1938.—The author reviews his own work on this subject [see Abstract 1772 (1937)] and also refers to that of F. Wolf [see Abstract 2806 (1937)]. He comments on the notable difficulties of the quantitative experimental study of the subject, firstly from the nature of the phenomena themselves, and secondly, from the fact that numerous secondary effects are often superposed. Curves are given illustrating the author's own observations on He^+, Ne^+ and A^+. One of the most interesting problems set by this general review of the results is that of the maximum of the efficacious sections of neutralisation with finite velocity which are in clear opposition to the theoretical predictions. J. J. S.

***3803. Generation Conditions for Rapid Carriers with H.F. Multiple Acceleration. E. O. Schlosser.** *Ann. d. Physik,* 32. 6. *pp.* 507–519, *July,* 1938.—A description is given of the apparatus, including the carrier source, and the properties of the positive carriers furnished by H and Hg are enumerated. By means of a suitable transformer it was found possible to increase the a.c. potential to more than double the applied potential at a frequency of 10^7. For determining the carrier velocity after multiple h.f. acceleration the method using electric deflection was not found suitable, but the magnetic deflection method proved satisfactory. A tube of the straight type built to give an acceleration equivalent to 200 kV was investigated, the carrier velocities being determined by the magnetic method. On account of discrepancies between the observed wave-lengths and the calculated values a new formula was derived, which gives more accurate values. By varying the accelerating potential it was found possible to obtain both Hg^+ and Hg^{++} carriers. A. W.

See also Abstracts 3644, 3653, 3654, 3655, 3671, 3735, 3736, 3875 and

2602B. Radiation Impulse from a Spark. M. Toepler.
2603B. Electrical Phenomena in the Positive Column at Low Pressure. W. Uyterhoeven.

CONDUCTION IN SOLIDS AND LIQUIDS.

3804. Effects of Electron Interaction on Energy Levels of Electrons in Metals. E. Wigner. *Faraday Soc., Trans.* 34. *pp.* 678–685, *June*, 1938.—The simplest form of the theory of the energy bands in metals which has afforded accurate explanations of often very intricate properties of metals and alloys, considers the metallic electrons as moving (without interacting among themselves) in a pre-existing field with the symmetry given by the space group of the crystal. This picture is now shown to fail in two respects : (1) The field is not preformed, but owes its origin partly to just those electrons whose motion is to be considered ; (2) the electrons move independently of each other. The author meets (1) by utilising the Hartree-Fock equations, and has found results which differ significantly from those of the simple theory ; (2) requires a consideration of wave functions beyond the Hartree-Fock scheme which will affect the density of the energy levels. The latter is carried out in two steps : (*a*) The building of wave functions out of the Hartree-Fock solutions which have the proper symmetry, *i.e.* belong to a definite multiplet system. (*b*) Combination of many wave functions with the same symmetry to obtain a better wave function. Finally the author is led to consider a model corresponding to an "inverted alkali metal." H. H. Ho.

***3805. Thermionic Voltmeter with a Linear Law. D. G. Reid.** *Journ. Sci. Instruments*, 15. *pp.* 261–263, *Aug.*, 1938.—An a.c. mains operated direct-reading voltmeter is described, the voltage range extending from 0·1 to 1·0 V., higher ranges being available by means of an input divider circuit. Frequency error is negligible up to about 1·5 Mc./sec. The meter is subject to wave-form error. AUTHOR.

3806. Unipolar Conductivity of Carborundum. J. K. Bose and S. R. Khastgir. *Zeits. f. Physik*, 109. 1–2. *pp.* 80–84, 1938.—By observations with a kathode-ray oscillograph it is shown that the rectifying action of a carborundum crystal clamped between two similar metallic points falls off continuously with increase in the applied a.c. voltage (50 ∼). The rectifying action is attributed to a unipolar volume conductivity of the crystal and not to surface (blocking layer) effects. W. S. S.

***3807. Cu_2O Rectifiers. H. Nöldge.** *Phys. Zeits.* 39. *pp.* 546–559, *July* 15, 1938.—The production of Cu_2O rectifying plates is described, and curves and calculations are given showing how formation of Cu_2O depends on the temperature, pressure, and oxidation period. The conductivities and rectifying properties of these plates are investigated, and the conclusion is reached that the best rectifiers are obtained by the oxidation of Cu in an annealing furnace at 900° C. and an air pressure of 10–15 mm. for a period of 30 min., followed by tempering for 2 hr. at 450° C. Aquadag is used to form contact between Cu_2O and the electrode, and improved rectification is obtained if the unit is finally submitted to a pressure of 300 to 500 kg/cm^2. The paper contains a Bibliography of 125 papers dealing with the construction and properties of Cu_2O photo-cells and allied subjects. R. W. P.

3808. "Overshoot Phenomenon" in Supraconductivity. A. D. Misener. *Cambridge Phil. Soc., Proc.* 34. *pp.* 465–469, *July*, 1938.—In a previous paper [see Abstract 5074 (1937)] experiments were described in which the "overshoot phenomenon" reported by Silsbee, Scott and Brickwedde might have been expected but was not observed. Silsbee has pointed out that the current densities used by Misener were appreciably smaller than the values he had found necessary to initiate "overshoots." Experiments using considerably higher current densities were therefore carried out. Again no evidence of "overshoots" was obtained. A sample of the Ta used by Silsbee, Scott and Brickwedde was specially investigated. Its high resistance ratio and lower than normal temperature for superconduction appear to indicate a lack of purity and it is concluded that the difference in behaviour of this sample and that used by Misener is due to difference in purity. From the fact that the continued unsteadiness of resistance observed with a straight specimen and the "overshoots" obtained with coiled specimens of the same material occur at similar regions of the transition curve, it is concluded that they are due to the same cause. This effect has been observed in specimens of simple shape only when of relatively impure material. With purer substances it has been observed only at excessively high current densities and with specimens of complicated shape. It has not been found with purer specimens of simple shape and hence seems to be a secondary effect in the transition from the superconducting to the nonsuperconducting state. A. W.

3809. Electrical Conductivity and Phase Diagram of Ni-Mo Alloys. G. Grube and H. Schlecht. *Zeits. f. Elektrochem.* 44. *pp.* 413–422, *July*, 1938.—The dependence of electrical conductivity upon temperature is investigated for alloys of the system Ni-Mo. The data obtained, augmented by the results of X-ray and microscopic examination and tests of hardness and corrosion, are embodied in a phase diagram. The diagram is incomplete, however, since the methods employed cannot detect one phase whose existence is proved by magnetic investigations to be described in a later paper. L. A. W.

3810. Electrolytic Conduction in Solids and Crystal Structure. J. A. A. Ketelaar. *Faraday Soc., Trans.* 34. *pp.* 874–882; *Disc.*, 882, *Aug.*, 1938.—The mechanism of conduction in the good ionic conductors is discussed. The case of Ag_2HgI_4 is discussed in detail in connection with the theory of Bragg and Williams on order-disorder transformations. The dependence of the energy difference V from the degree of order S, *i.e.*, the influence of the cooperation, is derived experimentally. Attention is drawn to the difference between true averaged structures and multiple twin structures. AUTHOR.

3811. Conductance of Aqueous Solutions of Electrolytes. D. A. MacInnes. *Frank. Inst., J.* 225. *pp.* 661–686, *June*, 1938.—Since the Debye-Hückel theory clearly indicates, from thermodynamic considerations, that strong electrolytes are substantially completely dissociated in aqueous solutions, it has been necessary to replace, in the explanation of the conductances of such electrolytes, the Arrhenius theory, which assumes partial dissociation and constant ion mobilities, with a theory which provides for changing mobilities with increasing ion concentrations. To this end Debye and Hückel, and Onsager, suggest two mechanisms: the "electrophoretic effect" and "the time of relaxation effect," both dependent upon interionic electrostatic attractions and repulsions. Experimental tests of Onsager's relations show that his equations account accurately, at least for very dilute solutions, for the changes with concentration of the conductances of solutions of electrolytes containing ions of widely differing mobilities and valencies. For higher concentrations semi-empirical equations are available. In contrast to the Arrhenius theory, the newer ideas call for changes in the transference numbers with the concentration, which have been found experimentally.

Precision transference measurements have also furnished an experimental test of Kohlrausch's law of independent mobilities of ions. The theory of interionic attractions and repulsions is, in addition, of utility in dealing with the ionic part of solutions of weak electrolytes. By computing degrees of dissociation in a manner which allows for changing ion mobilities a test is obtained of the Debye-Hückel limiting relation connecting activity coefficients with ion concentrations. AUTHOR.

3812. Limiting Conductivities of Organic Acids in Aqueous Solutions. J. F. J. Dippy. *Phil. Mag.* 26. *pp.* 93–98, *July*, 1938.—Working on the assumption that Onsager's equation holds for dilute aqueous solutions of Na salts of organic acids the author has employed a method of determining, with reasonable accuracy, the equivalent conductivity at infinite dilution which eliminates the necessity of making the modified solvent correction appertaining to salts undergoing partial hydrolysis. The procedure is justified in view of the agreement with determinations of other workers employing the more laborious calculations. Data are given for the Na salts of acrylic, vinylacetic, and allylacetic acids. H. H. Ho.

3813. Laws of Conduction in Semiconductors. F. Möglich. *Zeits. f. Physik*, 109. 7–8. *pp.* 503–509, 1938.—An internal ionisation effect is postulated to account for the phenomena of conduction in semiconductors. With the aid of the formula due to Saha, it is shown that two quite distinct laws of conduction are obtained, depending on whether the work of dissociation is large or small; these are borne out by experimental results. H. J. H. S.

3814. Electrical Conductivity and Thermoelectric Characteristic of Semiconductors. B. M. Hochberg and M. S. Sominski. *Phys. Zeits. d. Sowjetunion*, 13. 2. *pp.* 198–223, 1938. *In German.*—The thermoelectric power of the network Cu-semiconductor-Cu was investigated for WO_3, V_2O_5, CuO, Se, MoS_2, SiC, Bi_2S_3, Tl_2S, as well as for cobalt oxide. For most of these semiconductors parallel measurements of the thermo-e.m.f. and the electrical conductivity in dependence on temperature were carried out. In the case of Tl_2S the thermo-e.m.f. changes its sign depending on the concentration of the mixtures and the temperature. The results obtained are discussed in relation to the views on the diffusion of electrons and on positive " holes." J. J. S.

***3815. Galvanometer Giving Logarithmic Readings. Y. le Grand.** *Comptes Rendus*, 207. *pp.* 50–51, *July* 4, 1938.—Superposed on the current to be measured is one of opposite direction the intensity of which increases with the deviation of the galvanometer. This is effected by illuminating a suitable photo-cell with a beam of light reflected from the mirror of the galvanometer, a screen and diaphragm being so placed on its course as to modify its intensity suitably according to the movement of the mirror. The devices are figured. C. A. S.

See also Abstracts 3468, 3759, 3860, 3878 and

2626B. Measurement of the Specific Resistance of Liquids. A. Claassen.

DIELECTRICS AND CAPACITANCE.

3816. Calculation of Polarisability of a Molecule. M. M. Biedermann. *Physica*, 5. *pp.* 689–692, *Aug.*, 1938. *In English.*—A wave-mechanical discussion of the theory of Silberstein [see Abstract 772 (1917)] on polarisation of molecules is given. It is shown, that the additional polarisation of one atom by the electric dipole induced in another, can be described by using the perturbed wave function in the second-order approximation. AUTHOR.

3817. Dielectric Constants of Fluorine Compounds. R. M. Fuoss. *Am. Chem. Soc., J.* 60. *pp.* 1633–1637, *July,* 1938.—The total polarisation of a series of F compounds has been determined by Schering bridge measurements on the gases. By making reasonable assumptions concerning the electronic and atomic polarisations, values for their dipole moments were obtained as follows: CF_4, 0·0; CF_3Cl, 0·47; CF_2Cl_2, 0·55; $CFCl_3$, 0·53; CHF_2Cl, 1·41; $CHFCl_2$, 1·34; CHF_2Br, 1·30; CF_2Br_2, 0·72; CF_3CF_3, 0·0; $CClF_2CClF_2$, 0·0; CH_3CF_3, 2·27; CH_3CClF_2, 2·13; CF_3CF_2Cl, 0·14; CF_3CH_2Cl, 1·64. These figures are in agreement with the theory of induction between dipole moments. AUTHOR.

3818. Electric Moments of Methyl and Ethyl Alcohols. J. D. Stranathan. *J. Chem. Phys.* 6. *pp.* 395–398, *July,* 1938.—The dielectric constant of MeOH vapour has been determined by the heterodyne beat method of 14 temperatures between 25° and 206°; at each temperature measurements were made at an average of 23 pressures, ranging from approximately zero to almost saturation. The measured moment of MeOH is $1\cdot706 \pm 0\cdot005$ *D*. By taking the sum of the electronic and atomic polarisations as 8·6 a moment of $1\cdot688 \pm 0\cdot006$ *D* is obtained. The mean $(1\cdot698 \pm 0\cdot005)$ *D* is given as the most probable value. The data of Knowles [see Abstract 357 (1933)] on EtOH vapour have been recalculated by the method used for MeOH. The most probable moment of EtOH is $1\cdot702 \pm 0\cdot007$ *D*. [See Abstract 5077 (1937).] W. R. A.

3819. Electric Moments of NO_2 and N_2O_4 Molecules. R. W. Schulz. *Zeits. f. Physik,* 109. 7–8. *pp.* 517–537, 1938.—From measurements of the dielectric constants of mixtures of NO_2 and N_2O_4 at temperatures from 52° to 90° C. and at pressures of 200 to 562 mm. Hg, the electric moments of the NO_2 and N_2O_4 molecules are calculated to be $0\cdot29 \times 10^{-18}$ and $0\cdot37 \times 10^{-18}$ respectively. The electric moment of the NO_2 molecule is not found to vary with temperature, as reported by Williams, Schwingel and Winning [see Abstract 1815 (1936)]. E. R.

3820. Series Effect on Dipole Moments of Alkyl Halides in Solution. E. G. Cowley and J. R. Partington. *Chem. Soc., J. pp.* 977–983, *July,* 1938.—The effects of induction in the polar molecule and in the solvent by the principal dipole of various alkyl halides have been examined and a comparison has been made between the theoretical predictions and the experimental moments, measured in benzene at 20°. It has been found that the moments of the compounds increase as the series of *n*-alkyl iodides and bromides are ascended, and that the effect is greater in the former series. This is probably due to differences in properties between the polar groups. AUTHORS.

3821. Dielectric Properties of Carbohæmoglobins. S. Arrhenius. *Phys. Zeits.* 39. *pp.* 559–564, *July* 15, 1938.—From measurements of the dielectric properties of carbohœmoglobin solutions at wave-lengths from 92 to 1870 m., the relaxation times and dipole moments of the molecules are estimated. E. R.

3822. New Electrical Phenomenon. G. Piccardi. *Gazz. Chim. Ital.* 68. *pp.* 246–263, *April,* 1938.—A polarised dielectric by simple contact with water and other liquids with permanent dipolar moment, produces modifications of a non-elastic or non-completely-elastic nature, in the sense that they persist for some time after removal of the dielectric.

A modification "T" is obtained by means of (1) an electric field at an isolated armature, (2) an electrostatic machine immersed in the mass of liquid, (3) polarisation with Hg; and a modification "R" by arranging an apparatus in the form of a condenser with water electrodes and glass dielectric. The chemical and biological properties of these two varieties differ, and the possible effect on living organisms is discussed. In contact with a metallic spiral containing refrigerant, immersed in either modification, the "R" becomes "T" and the "T" becomes "R". The work is being continued. D. R. H.

See also Abstracts 3797, 3871.

ELECTROCHEMISTRY.

3823. Glow-Discharge Electrolysis. Part VII. A. Klemenc and H. Kalisch. *Zeits. f. phys. Chem.* 182. *Abt.A.* 2. *pp.* 91–102, 1938.—Continuing previous work [see Abstract 3237 (1937)] the authors find that glow-discharge electrolysis, like ordinary electrolysis, is influenced by the presence of small concentrations of certain substances. Thus for instance in the oxidation of $2N$ H_2SO_4 by glow-discharge electrolysis the yield is appreciably reduced by the presence of HCl at a concentration of only 10^{-3} N. This indicates that the oxidation of the H_2SO_4 takes place in the liquid phase. The presence of HCl at a concentration of $2 \cdot 10^{-2}$ N in the $2N$ H_2SO_4 lowers the anode fall by 23 V and the kathode fall by 11 V. [See following Abstract.] L. A. W.

3824. Glow-Discharge Electrolysis. Part VIII. A. Klemenc and H. Milleret. *Zeits. f. phys. Chem.* 40. *Abt.B.* 4. *pp.* 252–262, 1938.—The kathode and anode falls over certain electrolytes during glow-discharge electrolysis are measured by means of a probe electrode. The potential distribution in the discharge over $2N$ H_2SO_4 is investigated in detail. The conditions in the gas phase are found to be similar to those in a discharge with a metal electrode in place of the electrolyte. [See preceding Abstract.] L. A. W.

3825. Movement of Ions and Electrons in Solids and the Interpretation of Reactions between Solids. C. Wagner. *Faraday Soc., Trans.* 34. *pp.* 851–859; *Disc.*, 859–860, *Aug.*, 1938.—The movement of ions and electrons in solids is discussed and the work of other investigators in this field is reviewed. Movement of ions and electrons in solid ionic compounds is considered possible, and some typical cases are described qualitatively. The degree of disorder in AgCl can be calculated from the electrical conductivities of pure AgCl and of solutions containing $CdCl_2$ or $PbCl_2$ in AgCl. It is considered that diffusion processes are required in reactions between solids, the diffusion taking place in the layers of the reaction products. [*See* Abstract 3461 (1938).] F. J. B.

3826. Polished Electrodes and the Beilby Layer-Electrolyte Passage Zone. F. J. Taboury. *Comptes Rendus*, 206. *pp.* 1953–1955, *June* 27, 1938.—The limits within which the analogy between the Beilby layer-electrolyte passage zone and a small condenser shunted by a high resistance holds are further investigated, and the analogy shown to hold only for small p.d. and a large surface. [See Abstract 2788 (1937).
C. A. S.

***3827. Glass Electrode for Differential Titrations. M. Paić.** *Comptes Rendus*, 207. *pp.* 151–153, *July* 11, 1938.—The glass electrode described consists of a U-tube divided into two compartments by a very thin glass membrane, on opposite sides of which are placed the solutions

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193

which are to be titrated by the differential method. The p.d. between the two sides of the glass membrane is determined. A. J. M.

3828. Anodic Oxidation of Acid-Ester Salts. A. Hickling and J. V. Westwood. *Chem. Soc., J. pp.* 1039–1046, *July,* 1938.—A complete qualitative and quantitative study of the electrolytic oxidation of potassium ethyl malonate in aqueous solution has been made, and the effect of such variable factors as current density, concentration, acidity, temperature, anode material, presence of foreign kations and anions, and electrode potential on the current efficiency for the formation of ethyl succinate has been investigated. Possible anodic mechanisms are discussed, and it is concluded that none of the views previously advanced will account for the phenomena observed. A new theory, involving the intermediate formation of H_2O_2 at the anode, is put forward. AUTHORS.

3829. Normal Volta Potentials $\Delta\psi_0$ of Two-Phase Systems. O. Klein and E. Lange. *Zeits. f. Elektrochem.* 44. *pp.* 562–568, *Aug.,* 1938.—This paper records a continuation of previous work [see Abstract 4180 (1937)] on Volta potentials in electro-chemical two-phase systems, and deals in particular with recent determinations of normal Volta potentials $\Delta\psi_0$ and with the concentration and time-dependence of the surface potentials, χ, in highly concentrated solutions of electrolytes. The real heats of hydration are given for the alkali- and halogen-ions. The indirectly derived $\Delta\psi_0$ values were tested by direct experimental determinations from the solution systems Cu/Cu^{++}, Zn/Zn^{++}, and Ag/Ag^{+}. The paper concludes with a general discussion of the temporary changes which occur in the fine structure of solution surfaces ; graphical illustrations are included. A picture is developed of transition from a fresh to a more matured surface condition. H. H. Ho.

3830. Electrochemical Interpretation of Wagner's Theory of Tarnishing Reactions. T. P. Hoar and L. E. Price. *Faraday Soc., Trans.* 34. *pp.* 867–872 ; *Disc.,* 872–874, *Aug.,* 1938.—A metallic surface undergoing oxidation or tarnishing, with the production of a compact surface film of oxide, sulphide, etc., is regarded as a current-producing cell with the metal/film and the film/attacking substance interfaces as anode and kathode respectively, the film being both electrolyte and external circuit (since it has both ionic and electronic conductivities). An expression for the rate of tarnishing, similar to that originally obtained at some length by Wagner utilising the chemical potential function, is simply deduced. The similar expression for the more complicated case where the tarnish-film conductivity varies with the pressure of the attacking gas is also obtained electrochemically. The application of the theory to the explanation of tarnish-resistant metals and alloys is pointed out. AUTHORS.

See also Abstracts 3439, 3461, 3489, 3791, 3852 and

2595B. Optical Study of Negative Plate of Planté Accumulator in Operation. G. Valenti.

ELECTRONS, NEUTRONS, POSITRONS AND PROTONS.

3831. Production of Heavy Electrons. L. W. Nordheim and G. Nordheim. *Phys. Rev.* 54. *pp.* 254–265, *Aug.* 15, 1938.—The barytron theory of nuclear forces shows a close correspondence to the theory of the electromagnetic field. Estimates based on this analogy are given for the probabilities of the processes leading to actual production of barytrons. A comparison with the experimental evidence regarding the occurrence of barytrons in the cosmic radiation shows that the theoretical cross-sections are too small to explain the properties of the hard component. The difficulty is increased by the short lifetime of the barytrons which is estimated to be of the order $\sim 10^{-8}$ sec. from radiative β-decay. Therefore no simple picture of barytron production in terms similar to radiation theory can be given. This failure, however, indicates only the inapplicability of perturbation calculations, but does not constitute an actual disproof of the link between nuclear forces and cosmic radiation. AUTHORS.

3832. Most Probable Value of the Electronic Charge and other Related Constants for 1938. R. A. Millikan. *Ann. d. Physik*, 32. 6. *p.* 520, *July*, 1938.—Corrections. [See Abstract 2997 (1938).]

3833. Neutron Production through D Canal Rays. W. de Groot and F. M. Penning. *Physica*, 5. *pp.* 512–520, *June*, 1938. *In German.*—From the yield of the neutrons produced by D-ions impinging upon targets of D_3PO_4, Li, Be, C as measured by Amaldi, Hafstad and Tuve, the effective cross-sections for D, Li, Be and C as a function of the velocity v of the projectile are derived, using Mano's data for the range of charged particles in air and for the atomic stopping power of the elements. The yields as found by the authors named are extrapolated to lower energies. J. J. S.

3834. Formation of Deuterons by Proton Combination. H. A. Bethe and C. L. Critchfield. *Phys. Rev.* 54. *pp.* 248–254, *Aug.* 15, 1938.—The probability of the astrophysically important reaction $H + H = D + \epsilon^+$ is calculated. For the probability of positron emission, Fermi's theory is used. The penetration of the protons through their mutual potential barrier, and the transition probability to the deuteron state, can be calculated exactly, using the known interaction between two protons. The energy evolution due to the reaction is about 2 ergs/gm./sec. under the conditions prevailing at the centre of the sun (density 80, H content 35% by weight, temperature 2×10^7 degrees). This is almost but not quite sufficient to explain the observed average energy evolution of the sun (2 ergs/gm./sec.) because only a small part of the sun has high temperature and density. The reaction rate depends on the temperature approximately as $T^{3.5}$ for temperatures around 2×10^7 degrees. AUTHORS.

3835. Energy Loss of Fast Electrons by Radiation. L. A. Arcimovič and V. A. Chramov. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 7, *pp.* 415–417, 1938. *In English.*—A longitudinal magnetic field is used to focus the β-rays of energy 2 eMV from Rn and examination is made of the production of γ-rays when these electrons impinge on solid targets. Using C, Al, Cu, Sn and Pb as the bombarded elements and a counter at 50° to the incident beam the intensity of the γ-rays emitted is found to be proportional to Z. This behaviour is in qualitative agreement with the theory of Bethe and Heitler. The variation of intensity of the γ-rays for incident electrons of energies ranging from 0·67 to 3 eMV was also found to be in agreement with the theory, the latter predicting 2·9% for the radiation loss in Cu at 2·2 eMV, the observed value being $2{\cdot}8 \pm 0{\cdot}6\%$. F. C. C.

***3836. Transmission of Slow Electrons through Thin Collodion Films. M. Ference and R. J. Stephenson.** *Rev. Sci. Instruments*, 9. *pp.* 246–248, *Aug.*, 1938.—An apparatus is described for determining the transmission of slow electrons through thin collodion films. The range in accelerating voltages used was from 800 to 34,000 eV and the film thicknesses from 10^{-3} to 7×10^{-6} cm. AUTHORS.

3837. Photographic Intensity-Measurements of Electron Diffraction Patterns. L. S. Ornstein, H. Brinkman, A. Hauer and T. Tol. *Physica*, 5. *pp.* 693–700, *Aug.*, 1938. *In English.*—A photographic method for the measurements of electron diffraction patterns is developed and applied to the study of Cu and Ag films. The atomic factor electron diffraction shows a dependence on the angle of scattering different from the dependence found by previous investigators. AUTHORS.

3838. Secondary Emission of Beryllium. E. G. Schneider. *Phys. Rev.* 54. *pp.* 185–188, *Aug.* 1, 1938.—The secondary electron emission of Be films prepared by evaporation in a high vacuum has been studied. As the Be is deposited the secondary emission ratio (defined as the ratio of the number of electrons leaving the surface, to the number of primary electrons impinging on it) rises from that of the support metal to a value in the neighbourhood of 2·5. The position of the maximum with respect to energy of primary electrons remains near that of the support metal. As the thickness of the layer is increased the ratio falls to less than unity and the voltage of the primary electrons necessary to reach the maximum drops to about 200 V. Heating the thick Be layer to a bright red for a few minutes raises the emission to about 1·6 with the maximum at a primary energy of about 630 V. Oxidation of the surface increases the emission to about 4·1. Explanations of these effects are discussed and arguments are presented favouring the acceptance of the value of 1·6 as the maximum secondary emission ratio to be expected for pure bulk Be. AUTHOR.

3839. Secondary-Electron Emission from Ni, Co and Fe as a Function of Temperature. L. R. G. Treloar and D. H. Landon. *Phys. Soc., Proc.* 50. *pp.* 625–634, *Sept.* 1, 1938.—The evidence of other workers to the effect that the magnetic and structural changes which occur in ferromagnetic metals are accompanied by changes in the secondary-electron emission is critically discussed, and it is shown that this evidence is in many respects unsatisfactory. The authors have measured the secondary-emission coefficients for Ni, Co and Fe at various primary voltages over a temperature range of about 400° C., and find in all cases either no change or a slight and gradual fall in the coefficient with rising temperature, the latter effect probably being due to surface gas. No evidence was obtained of any discontinuous changes in secondary emission at the transformation points, though a change of less than 5% could readily have been detected. AUTHORS.

3840. Diffraction of Electrons by Oxide-Coated Kathodes. J. A. Darbyshire. *Phys. Soc., Proc.* 50. *pp.* 635–641, *Sept.* 1, 1938.—Electron-diffraction methods have been used to examine the surfaces of thermionic oxide-coated kathodes. The Ni kathodes were coated with a paste containing a solid solution of $BaCO_3$ and $SrCO_3$, and the diffraction camera was fitted up with ovens so that getter pellets could be fired off at suitable stages during the activation. These kathodes, after activation by heat treatment to give good emission, gave patterns of SrO alone when no getter had been fired off, but gave patterns of MgO along with SrO when the getter pellet (Ba-Mg alloy) had been fired off during the activation. Kathodes consisting of $BaCO_3$ alone before activation gave patterns of BaO after activation, whereas kathodes consisting of $SrCO_3$ gave patterns of SrO after activation. AUTHOR.

3841. Path of Electrons Through an Electrical Cylindrical Lens. W. Gaedcke. *Zeits. f. techn. Physik*, 19. 7. *pp.* 204–206, 1938.—An electron-optical analogue of a cylindrical lens is described in which there is a kathode of thoriated W wire 0·08 mm. dia. and 2 cm. long, an auxiliary screen and an anode assembly containing a slit. Curves are shown to illustrate the effect on the anode current of the anode voltage and of the kathode-screen distance for a constant radius of curvature of the auxiliary screen. The effect on the electron distribution on the screen of varying the auxiliary screen voltage with a constant anode voltage is also described. H. J. H. S.

See also Abstracts 3532, 3643, 3646, 3735, 3736, 3804, 3880.

ELECTROSTATICS.

***3842. Powerful H.V. Generator. A. Raskin.** *Comptes Rendus*, 206. *pp.* 1884–1885, *June* 20, 1938.—Certain mechanical, electrical and aerodynamic improvements in the design of a dust h.v. generator have raised the output to 500 mA at 400,000 V. G. C. E.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3843. Magneto-Resistance Change of Ferromagnetics in Alternating Magnetic Field. S. Sharan. *Indian Journ. Phys.* 12. *pp.* 203–210, *May*, 1938.—The resistances of Ni and Ni-Fe permalloy were studied under the effect of an alternating magnetic field alone and also under the effect of an alternating and a direct magnetic field simultaneously. It was observed that the application of a gradually increasing alternating field in the absence of a direct field produces no change in the resistance of the specimen, until it has a value equal to the coercive field of the specimen; and if the alternating field is increased beyond this value the resistance increases in the same way as it does in the case of the direct field. In the presence of a direct field, the alternating field first causes a decrease in the resistance and after a certain value has been reached, corresponding to which the resistance is minimum, the resistance begins to increase as usual. A definite relation was observed between this particular value of the alternating field and the direct field. Further, it was observed that the resistance of the specimen increases beyond its original value at zero alternating field, only when the alternating field is greater than the sum of the direct field and the coercive field of the specimen. Theoretical explanation of the above observations is given.

AUTHOR.

MAGNETISM AND ELECTROMAGNETISM.

3844. Domain Theory of Ferromagnetics Under Stress. Part III. W. F. Brown, Jr. *Phys. Rev.* 54. *pp.* 279–287, *Aug.* 15, 1938.—It is shown that the statistical theory of Parts I and II [see Abstract 2166 (1938)] can be extended so as to give formulæ for the magnetisation curve and other properties of an ideal reversible specimen, over the range of field values in which magnetisation proceeds by a displacement of the boundaries between domains. The application to actual specimens is made by assuming that the reversible properties of an actual specimen are identical with the properties, at the same magnetisation, of an ideal specimen having the same initial susceptibility. This leads to a formula for the reversible susceptibility of Ni and Fe that was originally suggested by Gans and verified by him experimentally, but for which it is believed no satisfactory derivation has hitherto been offered. In the case of one Ni specimen and of Co, where the data do not follow the Gans curve, formulæ agreeing better with experiment are obtained by taking account of the anisotropy of the domains. Reasons are given for believing that the replacement of variable by fixed domain volumes, an arbitrary step taken in order to simplify the problem, is probably not essential to the result. AUTHOR.

3845. Magnetic Anisotropy in Ferromagnetic Crystals in Weak Fields. E. Kondorsky. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 18. 6. *pp.* 325–327, 1938. *In English.*—The conclusions arrived at by Akulov and Bozorth to account for the magnetic anisotropy of ferromagnetics in weak fields contain assumptions concerning the initial state of the crystal before magnetisation. These are briefly examined from the viewpoint of the model of the process of weak field magnetisation due to Sixtus and Tonks and others and it is suggested that measurements of the reversible susceptibility of the crystals would be of value. H. J. H. S.

3846. Magnetic Properties of Ferric Hydroxide. R. Chevallier and S. Mathieu. *Comptes Rendus,* 206. *pp.* 1955–1958, *June* 27, *and* 207. *pp.* 58–61, *July* 4, 1938.—The spontaneous transition of moist ferric hydroxide to either α-Fe_2O_3 or to gœthite (α-$Fe_2O_3.H_2O$), I, has been studied by magnetic measurements at various times after precipitation and with variations in the concentrations of the Fe··· and OH′ ions. For the first two hours the susceptibility increases regularly; thereafter a more rapid increase with time takes place until a maximum value is attained at about 20 to 30 hr.; a decrease then takes place. The total susceptibility (χ) is the sum of the initial susceptibility (χ_0) and a susceptibility variable with time (χ_1). Variation of [Fe···] or [OH′] has little effect on χ_0. χ_1, however, is considerably influenced by [OH′] but uninfluenced by [Fe···]. A relationship between the magnetic properties of moist- and dry ferric hydroxides of equal age and at identical OH′ concentrations has been found. Ferric hydroxide formed in alkaline media contains (I), which can be isolated by nitric acid, and a ferric hydroxide insoluble in nitric acid (II). The individual contributions of (I) and (II) are considered. The susceptibility of (I) is small, whilst that of (II) is high and increases with time. The high value for (II) may arise from the presence of some ferromagnetic ferric oxide formed during the precipitation of the ferric hydroxide; this theory has not yet been probed but evidence of the heterogeneity of (II) is cited in its favour. W. R. A.

3847. Magnetic Susceptibility and Phase Diagram of Ni-Mo Alloys. G. Grube and O. Winkler. *Zeits. f. Elektrochem.* 44. *pp.* 423–428, *July,* 1938.—Temperature-susceptibility curves are given for alloys of the Ni-Mo system ranging from pure Ni to pure Mo over the temperature interval 0–1400° C. The phase diagram of the system is deduced from the discontinuities in these curves, aided by X-ray data. Isotherms of specific susceptibility of the alloys at 800, 900 and 1000° C. show, in the same way as the isotherms of electrical conductivity, a linear path in the heterogeneous state and a progressive curve in the homogeneous state whilst the phase limits in the constitution diagram appear as changes in direction of the isothermals. [See Abstract 376 (1937).] H. J. H. S.

3848. Change of Thermal Energy with Adiabatic Change of Magnetisation in Iron, Nickel and Carbon Steel. T. C. Hardy and S. L. Quimby. *Phys. Rev.* 54. *pp.* 217–223, *Aug.* 1, 1938.—Previous methods for measuring the change in thermal energy which occurs when the magnetisation of a ferromagnetic material is altered adiabatically have been so improved as to permit a precise study of this phenomenon in magnetically soft materials. The materials here dealt with are carbon steel, and annealed and unannealed Armco iron and nickel. The change in thermal energy of each of these substances is traced through a complete half-cycle of magnetisation which starts with the maximum value of the intensity of magnetisation. The external work done by the specimen at each stage of the process is likewise evaluated. The decrease in thermal energy on demagnetisation is less than the external work done by the specimen in iron and steel, while in unannealed nickel it is greater. In annealed nickel the decrease in thermal energy is greater than the external work when the magnetisation process is continuous and less when it is discontinuous. AUTHORS.

3849. Magnetic Viscosity in Iron. C. W. Heaps. *Phys. Rev.* **54.** *pp.* 288–293, *Aug.* 15, 1938.—Magnetic viscosity—the change of induction occurring after the magnetising field has ceased to vary—has been measured in a bar of commercial iron, with a measuring circuit designed to eliminate spurious effects arising from sparking at switches. Magnetic viscosity is found to depend on previous magnetic states, in agreement with observations of Mitkevitch and contrary to Preisach's results. It appears, therefore, as if reversible domains could retain their lagging propensity while the magnetic force is varying over a considerable range. The viscous effect is found to depend on the magnitude of the previous change of induction if the latter is small, but is independent of this change if it is greater than 60 gauss. In small, subsidiary hysteresis loops, such as are used in determining reversible permeability, it is found that the Barkhausen effect is not present although there is hysteresis and magnetic viscosity. It is therefore concluded that the movement of the boundaries of saturated domains in the material is subject to time-lag. AUTHOR.

3850. Magnetic Behaviour of Diamagnetic Salts at Lattice Change Points. G. E. R. Schulze. *Zeits. f. phys. Chem.* 40. *Abt.B.* 4. *pp.* 308–318, 1938.—The change in susceptibility of NH_4Br, NH_4NO_3, KNO_3, $TlNO_3$, AgI, and Ag_2S is investigated by the method of Curie and Chéneveau [see Abstract 1762 (1910)] of balancing the force set up when the specimen is placed in a non-uniform magnetic field. The corrections to be applied are discussed. In no case does susceptibility alter by more than 4%, while in the case of $BaSO_4$ in which anisotropy of the crystal units is not specially marked, the alteration is about 10%. It appears therefore that the observed change can easily be explained by the alteration in atomic arrangement, without assuming any change in the state of the atoms themselves. On the other hand in the transfer from diamond to graphite ($-0{\cdot}495\times10^{-6}$ to $-3{\cdot}0\times10^{-6}$) and from grey to white tin ($-0{\cdot}25\times10^{-6}$ to $+0{\cdot}026\times10^{-6}$), in which the electron configurations are most certainly altered, the change in susceptibility is quite marked. D. R. H.

3851. Accurate Measurements of Magnetic Susceptibilities of Rare Earths by the Faraday Method. B. Cabrera. *J. de Physique et le Radium*, 9. *pp.* 209–227, *June*, 1938.—Examination of certain rare-earth salts by the Faraday method, with special precautions which are discussed, leads to the conclusion that the Weiss whole number law agrees with experimental data better than the values obtained from the theory of Hund and van Vleck. W. R. A.

3852. Potentiometric and Magnetometric Study of the Duroquinone System. L. Michaelis, M. P. Schubert, R. K. Reber, J. A. Kuck and S. Granick. *Am. Chem. Soc., J.* 60. *pp.* 1678–1683, *July,* 1938.—Duroquinone in a strongly alkaline solution forms a free paramagnetic semiquinone radical of brown colour as intermediate step of the reduction. There is no dimeric form of this radical ; in other words, no compound corresponding to the ordinary crystalline benzoquinhydrone, which is a dimeric diamagnetic molecule, is formed from duroquinone and durohydroquinone either from alkaline or acid solutions. Solid benzoquinhydrone is a compound formed from quinone and hydroquinone by two hydrogen bonds. These bonds cannot be formed in duroquinone due to steric hindrance. The maximum percentage of the duro-semiquinone radical in equilibrium with its parent substances continuously increases with increasing pH. At pH 13 this maximum is about 50%, a result which is the same whether derived from potentiometric or magnetic observations. AUTHORS.

3853. Magnetic Susceptibilities of Inorganic Complex Compounds. J. H. Frazer and N. O. Long. *J. Chem. Phys.* 6. *pp.* 462–465, *Aug.,* 1938.—A standard method used in the determination of the gyromagnetic effect has been so modified as to permit the determination of magnetic susceptibilities. Its use is suggested for the determination of the susceptibilities of complex compounds, since it utilises weak fields, and also requires only a small amount (less than 0·5 gm.) of the material to be tested. The susceptibilities of some compounds containing NO have been measured. AUTHORS.

3854. Paramagnetic Relaxation in Iron Ammonium Alum at Low Temperatures. W. J. de Haas and F. K. du Pré. *K. Onnes Lab., Leiden, Comm. No.* 253*a*. *Physica,* 5. *pp.* 501–506, *June,* 1938. *In English.*—By adiabatic demagnetisation of certain paramagnetic salts extremely low temperatures can be obtained. The question arises whether these low temperatures must be ascribed only to the spin system or whether they also hold for the crystal lattice. It is possible that the temperature equilibrium between spins and lattice establishes itself so slowly that in the time available for the experiments this equilibrium is not reached. That this occurs is the view of Heitler and Teller from their calculation of the relaxation time, T, for this equilibrium. Even at 1° K. in a magnetic field of 2000 gauss T is of the order of 100 sec. for the usual substances. The authors of the present paper conclude from their experiments that the relaxation time T of the spin-lattice equilibrium is substantially smaller than the Heitler-Teller value. They find at 1·22° K. in a longitudinal field of 2000 gauss a considerable dependence of χ', the thermal value of the susceptibility, on the frequency at about 15∼. As to the transverse effect the relaxation time will be substantially smaller for in that case the interaction between spins and lattice does not play an important part. [See following Abstract.] J. J. S.

3855. Thermodynamic Interpretation of Paramagnetic Relaxation Phenomena. H. B. G. Casimir and F. K. du Pré. *K. Onnes Lab., Leiden. Comm. Suppl. No.* 85*a*. *Physica,* 5. *pp.* 507–511, *June,* 1938.—*In English.*—Referring to the paper on paramagnetic relaxation [see preceding Abstract] the authors in the present paper endeavour to arrive at a quantitative understanding of the results, and they derive a definite value for the time constant of the spin-lattice equilibrium. The result confirms the conclusion previously reached that Heitler and Teller's estimate gives an incorrect order of magnitude. J. J. S.

3856. Paramagnetism of the Ferromagnetic Elements. W. Sucksmith and R. R. Pearce. *Roy. Soc., Proc.* 167*A*. *pp*. 189–204, *Aug*. 5, 1938.—A method is described for measuring magnetic susceptibilities in a controlled atmosphere or *in vacuo* at temperatures up to 1500° C. The special precautions required to prevent solid diffusion and minimise evaporation in measurements on metals are discussed. Accurate measurements on the susceptibilities of the ferromagnetic elements, hitherto confined to nickel, are extended to Co and Fe. The magneton numbers for both these elements are deduced to an estimated accuracy of 1–2% from the experimental data. It is shown that the existing theory is inadequate to explain the new results obtained. AUTHORS.

3857. Principal Paramagnetic Susceptibilities of Potassium Ferricyanide at Low Temperatures. L. C. Jackson. *Phys. Soc., Proc.* 50. *pp*. 707–710, *Sept*. 1, 1938.—The author's previous measurements of the principal magnetic susceptibilities of $K_3Fe(CN)_6$ have been repeated and extended to a temperature of 14·2° K. Two of the principal susceptibilities are approximately equal throughout the whole temperature range from 290 to 14° K., but that along the third principal axis is considerably smaller. The anisotropy is almost 400% at 14° K. and is still increasing as the temperature falls. A brief comparison with Howard's theory of the magnetic properties of $K_3Fe(CN)_6$ is made. AUTHOR.

3858. Further Measurements of the Magnetostriction of Liquid Oxygen. M. Wolfke. *Acta Physica Polonica*, 7. 1. *pp*. 81–85, 1938. *In German*.—The magnetostriction of liquid oxygen at its normal boiling point is measured with an improved apparatus. The increase of specific volume produced by a field of H Gauss is found to be $2\cdot0\times10^{-14}H^2$. R. P.

3859. Effect of Temperature on Elastic Modulus of Ferromagnetic Substances. W. Döring. *Ann. d. Physik*, 32. 5. *pp*. 465–470, *July*, 1938.—The variation with temperature of the elastic modulus of a Ni-Fe alloy containing 42% Ni, magnetised to different degrees, is described. A value of $1\cdot62\times10^{12}$ dynes/cm^2. (E_H) is obtained by O. Engler for this alloy at room-temperature and magnetised to saturation whilst by extrapolation from above the Curie Point a value of $1\cdot80\times10^{12}$ dynes/cm^2. (E_M) is obtained at room-temperature for constant magnetisation; the relative difference E_M-E_H/E_M is thus about 10%. In other alloys and in pure metals the difference is much smaller. The large value of the difference in this particular alloy seems to be due to its large volume magnetostriction effect in comparison with that in other alloys where the differences are too small to be measured experimentally. H. J. H. S.

3860. Gyromagnetic Effect in Supraconductors. I. K. Kikoin and S. V. Goobar. *Comptes Rendus* (*Doklady*) *de l'Acad. des Sciences, U.S.S.R.* 19. 4. *pp*. 249–251, 1938. *In English*.—A brief description is given of measurements of the gyromagnetic effect on supraconductors, using the resonance method proposed by Einstein. A ball of Pb is used and the current is alternated by means of a special thyratron relay; in this way the secondary effects are practically eliminated. The Einstein-de Haas effect occurs in Pb at the boiling point of liquid He in fields below the critical one and the sign is negative (as would be expected for electrons). The existence of a gyromagnetic effect is thus not due to the influence of

V. 19

electron inertia in eddy currents (Tolman effect) for these cannot arise in the specimens used. The results will be described in detail later.
H. J. H. S.

See also Abstract 3796 and
2614B. Rheographic and Rheometric Analogies. J. Pérès and L. Malavard.
2617B. Law of Reaction in Electrodynamics. M. Wolfke.
2659B. Permanent Magnets. G. Venco.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3861. Electric Conduction of Self-Polarising Bodies. N. N. Malov. *Comptes Rendus (Doklady) de l'Acad. des Sciences, U.S.S.R.* 18. 8. *pp.* 569–573, 1938. *In German.*—The phenomena observed on passing current through living tissues (in particular, the frequency relations of the exciting wave and the impedance) show that, at the boundaries of the tissue, a strong polarisation occurs. A theory is developed to account for the complicated frequency relations which occur in animal and human tissues, and graphs are given in illustration. The impedance has 2 components, one " active " and the other " capacitative ", each of which is affected by frequency in a different manner. H. J. H. S.

***3862. Radiographic Models. W. E. Boyd.** *Brit. J. of Radiology,* 11. *pp.* 444–451, *July,* 1938.—These are models to illustrate the effect of a divergent beam on the projection of shadows from opaque bodies situated at various depths and positions : this effect is, in brief, that the apparent sizes and positions are not identical representations of the actual sizes and positions of the objects. One model is a sheet of wood with opaque drawing pins at various positions in its surface and can be used to show the effect of increasing distance between the pins and the focal spot, on passing out towards the edges of the surface. The other model is a wooden block with pins fixed in its front and back surfaces : this model can be used to illustrate the effect of having the opaque bodies at different depths from the focal spot. G. G.

3863. Physical Measurements in H.V. X-Ray Therapy. R. Phillips and G. S. Innes. *Brit. J. of Radiology,* 11. *pp.* 498–503, *July,* 1938.—The paper reports physical measurements of intensity, absorption, quality, scatter and percentage depth dose, made at 700 kV on the h.v. X-ray therapy apparatus at St. Bartholomew's Hospital. Transmission curves and half-value layers have been obtained in Cu, Sn, Pb and H_2O. For preliminary clinical work the filter chosen is 3·2 mm. Fe, 1·5 mm. Al, 2·0 mm. Pb, 2·4 mm. Sn, 0·5 mm. Cu and 1·0 mm. Al, giving an effective wave-length of 0·033 Å. Measurements of back scatter from a wax phantom show a constantly decreasing value with kilovoltage, down to about 10% at 700 kV. The isodose curves show the higher intensity in the half of the beam on the anode side of the vertical axis, as predicted by Corrigan. The variations of depth dose with voltage, filtration, field area, and focus skin distance have been investigated and curves are given ; it is shown that filtrations beyond 2·0 mm. Pb give only negligible increases in percentage depth dose. The fact that the maximum percentage depth dose at any depth is a function of the quality of the radiation is illustrated by the curves given. J. E. R.

3864. Geometrical Factors in Measurement of Radiation in Röntgens. C. C. Lauritsen. *Brit. J. of Radiology,* 11. *pp.* 471–478, *July,* 1938.—A theoretical discussion of two ambiguities in the definition of the röntgen. (1) It is not stated whether scattered radiation shall be included or not in the measurement but usage has established that it shall not be included. (2) The definition is based on the ionisation produced per cm.^{3} in air. It is customary and convenient to measure instead the ionisation produced in an unknown volume by the electrons originating per cm.^{3} of air at a certain point and this is usually a very different thing. Difficulties arise in the measurements, if the radiation is of short wavelength and the medium is air, then the electrons may have a range of several metres. In the case of γ-rays from a point source, three cases are considered, *i.e.*, measurements in a sphere of air equivalent material of which the radius is 1 cm., 10 cm., and finally the whole range of the electrons, several metres. It is concluded that a suitable thick-walled thimble chamber can be expected to give readings which are independent of distance, in which the compensation is 100%. T. A. C.

3865. γ-Ray Measurement in Radiology. G. C. Laurence. *Am. J. of Roentgenology and Radium Therapy*, 40. *pp.* 92–103, *July*, 1938. —The calibration of thimble chambers for the measurement of γ-rays in roentgens is discussed. The correction that should be applied because the materials used in the walls of these chambers are not generally "air equivalent" is described and data are given for evaluating it under various conditions. When thus corrected the recently published measurements of the intensity of γ-rays filtered through 0·5 mm. of Pt from 1 mg. of Ra in equilibrium with its products at 1 cm. distance agree with a mean deviation of 2% from the value 8·4 roentgens per hour. The design of thimble chambers and phantoms for γ-ray measurement is discussed. Present uncertainties about the meaning of the roentgen under practical conditions have hindered the use of these units in γ-ray therapy. Certain conventions are proposed to remove these uncertainties. The density of ionisation per roentgen in any material varies considerably with the nature of adjacent materials and is probably an important factor in determining the biological effects of γ-ray exposure of the skin. The approximate measurement of the variation in the density of ionisation per roentgen in a solid material is described. AUTHOR.

3866. Measurements of Radiation Energy and True Tissue Dosage (Energy Absorption) in H.V. Therapy. L. Rovner. *Am. J. of Roentgenology and Radium Therapy*, 40. *pp.* 104–107, *July*, 1938.— The increasing agreement found among recent independent evaluations of the air ionisation constant for Ra γ-rays emphasises the present opportunity of next converting this and other ionisation measurements into true dosage values. As demonstrated by Lauritsen only the evaluation of the true energy absorption serves as a proper means for comparing clinical dosages or for investigating biological effects of different radiations. The recent work of Gray has shown that these energy measurements may become established upon a sound theoretical and experimental basis. Since the formation of ions of the liberation of high speed ionising particles in an irradiated medium is always the result of true energy absorption of the radiation in the medium, it is suggested that this absorbed energy quantity, itself, be used to express dosage. In this case the dosage may be stated in ergs or in microcalories of radiation energy absorbed per cm.^{3} of tissue. AUTHOR.

3867. Estimation of Dosage from Flat Radium Applicators. M. C. Reinhard and H. L. Goltz. *Radiology*, 31. *pp.* 151–154, *Aug.*, 1938.—Tables and charts are presented showing the relationship between radiating area and intensity expressed in r./mg.–hr. These were primarily developed for use in connection with intra-oral applicators of radium, but may be used for any surface applicator at any distance from 0·5 to 5 cm. for areas up to 40 cm^3. AUTHORS.

3868. Quantum Processes in Radiobiology. K. Sommermeyer. *Zeits. f. Physik*, 109. 5–6. *pp.* 332–340, 1938.—It is suggested that neither the passage of a fast electron nor the formation of an ion in a sensitive region of a biological object irradiated by X-rays or γ-rays can be regarded as a hit. A more general definition of an effective hit is put forward. On this basis it is to be expected that for short wave-lengths the half-value dose, and the number of hits required to produce any biological effect, will be independent of the wave-length ; for longer wave-lengths variations will occur in accordance with Glocker's theory. J. E. R.

3869. Action of Radiations on Biological Materials Capable of Recovery. Part I. D. E. Lea. *Brit. J. of Radiology*, 11. *pp.* 489–497, *July*, 1938.—One cause of the intensity-dependence of the effect produced by a given dose of radiation is the existence of recovery in the biological material irradiated. In cases where a single unit action (ionisation, etc.) only is required to produce the effect, recovery is of no significance and dose is independent of intensity. Theoretical dose-intensity curves are produced for the cases of irradiation of recovering biological materials in which n, the number of unit actions required to produce an effect $= 2$ and for $n = \infty$. It is shown that for these extreme conditions the curves are of practically identical shape. Satisfactory comparison is made between the theoretical curves and published experimental data on drosophila eggs and tissue cultures. [See following Abstract.] J. E. R.

3870. Action of Radiations on Biological Materials Capable of Recovery. Part II. D. E. Lea. *Brit. J. of Radiology*, 11. *pp.* 554–566, *Aug.*, 1938.—A theory is advanced to explain the delay in division which is one of the effects of radiation upon cells. The theory is based upon the concept of the cumulative dose, and supposes that the cumulative dose in a cell decays exponentially after the end of the irradiation. When it falls below a certain threshold, division is no longer inhibited. This recovery process following irradiation is not essentially different from the recovery during irradiation which in Part I [see preceding Abstract] was postulated to explain the dependence of the effect of radiation upon intensity, and this inter-relation of the two phenomena is demonstrated by consideration of published work on Arbacia eggs and on tissue cultures. Fair agreement is obtained between the predictions of the theory and the experimental result. In particular it is shown that the variation of the mitotic count in a tissue culture during a period of some hours following irradiation can be predicted using numerical data drawn exclusively from experiments which ended 80 min. after the irradiation. AUTHOR.

See also Abstract 3608.

OSCILLATIONS AND WAVES.

3871. Determination of the Frequency of an Oscillator With a Condenser. H. Mukherjee. *Indian Journ. Phys.* 12. *pp.* 195–202, *May*, 1938.—With an a.c. galvanometer of the form of a watt-meter or a dynamometer null point is obtained under two conditions, namely, (1) when the current through either the fixed or the moving coil is zero and

(2) when the phase difference between the currents in the two systems of coils is 90°. In the method described, advantage is taken of the second condition. The resistances and the condenser are arranged in the arms of a Wheatstone net, the moving coil in one of the diagonal arms and the fixed coils in series with the current source in the other diagonal arm. It is shown that the phase-difference between the currents in the two systems of coils is 90° when $\frac{1}{C^2p^2} = \frac{Q}{P} R \left\{ R + \frac{G(P+Q)}{P+Q+G} \right\}$. AUTHOR.

3872. F-Region of the Ionosphere. R. R. Bajpai and B. D. Pant. *Indian Journ. Phys.* 12. *pp.* 211–222, *May*, 1938.—The results of ionisation measurements in the F-region during Oct., Nov. and Dec., 1936, are reported. A number of typical curves showing the diurnal variation of electron density are given and their salient features discussed. Separate existence of the F-region has been observed till a few hours after sunset. Evidence is summarised to show that solar theory of upper atmospheric ionisation is inadequate to explain all the observed phenomena. Either the theory should be modified or some other source or mechanism of electron production should be found out. AUTHORS.

3873. Total Reflection of Electromagnetic Waves in the Ionosphere. S. N. Bose. *Indian Journ. Phys.* 12. *pp.* 121–144, *April*, 1938.—Beginning with the microscopic equations of Lorentz, a wave disturbance is represented by equating all varying quantities to the sum of a constant and a variable part, thus: $A = A_0 + A_1e^s$, where S is an unrestricted function, real or complex, of x, y, z, and t. The electromagnetic equations are then developed and discussed in terms of the electric and magnetic vectors E and H, grad S, θ (the amplitude of θe^s, the variable part of the convection current), and θ_0 the amplitude of the variable charge density. The refractive index, defined as $\mu = (\text{grad } S)/(1/c)(dS/dt)$ is next introduced. It is then shown that when $dS/dt + E \cdot \theta/c^2 = 0$, $(H^2/E^2)\ (dS/dt) = 0$, so that $H = 0$, and the disturbance loses its wave character. At the same time the flow of energy across the wave front vanishes, and the equation is therefore taken as the definition of total reflection. Although when $E \parallel \theta$, the condition is equivalent to the assumption $\mu = \theta$, in the general case the condition is that of vanishing group velocity. These results are now applied to the ionosphere, and equations for critical frequencies are deduced which in simpler cases agree with the usual formulæ if collision frequency is neglected. In the more general case, however, the critical frequency formula turns out to be that first deduced by Bajpai and Mathur [see Abstract 4220 (1937)], on the assumption that the group velocity is zero at total reflection. Finally the propagation of the disturbance is discussed in the most general case and the critical frequency equations of Bajpai and Mathur arrived at by another method. J. P. A.

3874. Reflection in the Ionosphere. I. Mihul and C. Mihul. *Comptes Rendus*, 207. *pp.* 220–222, *July* 18, 1938.—The conclusions of Ionescu and Mihul [see Abstract 704 (1935)] as to partial reflections in the ionosphere have been criticised by Best, Farmer and Ratcliffe [see Abstract 375 (1938)]. This criticism was based on the remark that the composition of certain elementary vibrations reflected at successive layers of the ionosphere would lead to an amplitude of negligible magnitude.

It is claimed that the present rigorous calculations show that an amplitude of notable magnitude can be obtained. The difference between the reflection of waves of broadcast wave-lengths and of short waves is mentioned and the considerations applicable to the two cases are discussed.
G. G.

3875. Effect of Longitudinal Magnetic Field on Conductivity and Refractive Index of Ionised Air. B. N. Singh. *Phil. Mag.* 26. *pp.* 244–252, *Aug.*, 1938.—Conductivity and refractive index of ionised air have been determined in the presence of applied longitudinal magnetic field. The measurements were made with ultra-short waves of frequency $8 \cdot 1 \pm 10^7$ cycles per sec. passing through a discharge-tube containing the ionised air. Variations of the above constants were found as the magnetic field was increased. A complete dispersion formula of the ionised gas in the presence of the magnetic field has been employed for the purpose of verifying the experimentally observed values of the above constants. The values of electron density (N) and collisional frequency (ν) were determined by " probe " method of Mott-Smith and Langmuir. It has been found that the values of conductivity and refractive index do not reach infinity at about gyro-frequency of the incident wave when the magnetic field is increased, as is generally expected, from the approximate formulæ obtained by neglecting the collisional frequency. AUTHOR.

See also Abstracts 3561, 3600, 3699 and

2640B. Absorption of H.F. Energy in Geissler Tubes. V. P. Mihu.
2788B. Abnormal Ionisation in the E-Region. J. A. Pierce.
2789B. Radio Transmission Path and Magnetic Storm Effects. G. W. Kenrick, A. M. Braaten and J. General.
2790B. Sudden Ionospheric Disturbances. J. Maire.
2791B. Limit Waves and the Ionosphere. O. Burkard.
2792B. Dispersion of Electromagnetic Waves above the Earth's Surface. J. L. Alpert, V. V. Migulin and P. A. Riasin.
2801B. H.F. Technique. K. Krüger.

PHOTOELECTRICITY.

3876. Effect of H.F. Oscillations on Photoelectric Currents. T. Terada. *Kyoto Coll. Sci., Mem.* 31. *pp.* 39–46, *May*, 1938. *In English.*—The electric current from a photo-cell increases when a very high frequency oscillation of a few volts is superposed upon a continuous voltage. This peculiar effect depends upon the intensity of illumination and the frequency of the oscillatory voltage, but is nearly independent of the temperature. The effect may be explained at least partly by the disturbances of the negative charge accumulated in front of the kathode of the cell. From this point of view, it is suggested that a critical frequency of the electrons in the cell is about 2140 kc./sec. AUTHOR.

3877. Photoelectric Sensitivity of ZnO. E. Hoja. *Zeits. f. phys. Chem.* 40. *Abt.B.* 4. *pp.* 263–272, 1938.—From a study of two different samples of ZnO and of the effect of changing the amount of hydrated water it is concluded that the presence of the latter increases the magnitude of the Becquerel effect. If the hydrated oxide plays the part of a kathode depolariser the results may be reconciled with Baur's theory. G. C. E.

✱3878. Photoelectric Contact-Making Galvanometer. W. L. Carson. *Gen. El. Rev.* 41. *p.* 314, *July*, 1938.—A brief account of the instrument and its applications is given. The mirror of a galvanometer reflects a light beam upon a scale, where two adjustable photo-cells intercept it for any desired set values indicated by pointers. Each photo-cell actuates an electronic relay. The principal application of the instrument probably lies in the field of temperature control. L. A. W.

See also Abstract 3807.

PIEZOELECTRICITY.

3879. Velocity of Propagation of Elastic Waves in Piezoelectric Crystals. E. Baumgardt. *Comptes Rendus,* 206. *pp.* 1887–1890, *June* 20, 1938.—For plates of piezoelectric crystals of thickness *e*, calculations based on the values of the elastic constants are found to give values for the product of frequency (*f*) and thickness which are smaller than the values found experimentally. Thus the value found for quartz is $fe = 283 \cdot 8$, *f* being in kc/sec., whereas experimental values range between 285·9 and 287·5, the value generally accepted being 287·0. It is considered that the volume charges created in a vibrating quartz plate by the variation in space of the polarisation vector, tend to increase the value of E^1 (a coefficient similar to Young's modulus) and, in consequence, the value of *f*. Calculations made on this assumption give for quartz a value for *fe* of 285·2. It is concluded that the small difference still existing between this and the experimental figure is due to lack of exactness in determining one of the elastic constants, into the calculation of which 6 different coefficients enter. A. W.

THERMIONICS.

3880. Electron-Optical Examination of Electronic and Ionic Emission from Wires. H. Mahl. *Zeits. f. Physik,* 108. 11–12. *pp.* 771–776, 1938.—A method is described using an auxiliary electrode for converting ionic emission into secondary electron emission so that, if a wire emits both positive and negative particles, each leads to images formed by the same lens on the same screen. The method is illustrated by experiments on an indirectly heated steatite tube. H. J. H. S.

See also Abstracts 3520, 3760.

THERMOELECTRICITY.

3881. Method of Least Squares and Thermoelectric Power of Rhodium. H. T. Wensel and L. B. Tuckerman. *Rev. Sci. Instruments,* 9. *pp.* 237–241, *Aug.,* 1938.—The paper by Booth and Dixon [see Abstract 5132 (1937)] is critically reviewed. The care necessary in the application of the method of least squares to physical data is discussed with references to articles giving detailed treatments. The method of least squares is then applied to Booth and Dixon's data. It is shown that: (1) The conclusions drawn by Booth and Dixon are invalid because based upon an invalid use of the method of least squares. (2) Their data are inadequate to prove the existence of a discontinuity. (3) No discontinuity of the order of magnitude reported by Booth and Dixon exists in the thermoelectric power of Rh in the neighbourhood of 1100° C. (4) No valid evidence has been adduced for a change in structure of Rh in the neighbourhood of 1100°C. In fact evidence is to the contrary. (5) Other reported "irregularities" of the behaviour of Rh in the neighbourhood of 1100°C can reasonably be ascribed to the formation and decomposition of a surface film of rhodium oxide. *Reply* by **E. T. Booth** and **E. H. Dixon,** *ibid. pp.* 242–243. AUTHORS.

See also Abstract 3814.